Sinking a Coal Shaft.

A correspondent of the Philadelphia *Press* describes as follows the sinking of a new shaft on the coal lands of the Lehigh Valley Co:—

In the matter of improved appliances and perfect methods of mining and preparing coal there is, perhaps, no individual or corporation that has kept pace with the management of the Lehigh Valley Coal Company. This company owns the four largest and best collieries in the Shenandoah Valley—the richest coal basin in the world—and, notwithstanding the present unfavorable outlook of business, is opening another—the largest colliery in the whole anthracite coal field. These collieries are known as Packer Nos. 1, 2, 3 and 4, and the new mammoth colliery will be known as Packer No. 5. This colliery, which is being opened on the North side of Bear Ridge Mountain, at Rappahannock Station, on the Girard estate, will consist of a shaft 1,200 feet deep and a breaker supplied with all the most improved methods for the preparation of coal. Its productive capacity, when in full operation, will approximate 3,000 tons daily.

The sinking of the shaft was begun a year and a-half ago, and a depth of 515 feet, at which the first seam is intersected, has now been attained. The shaft is in dimensions 13 feet by 48 feet, divided into six-compartments, comprising four hoisting-ways, an apartment for ventilation and another for a pump and traveling way. Tunnels driven north and south across the measures will intersect all the seams at the present depth, while the two compartments, or half of the present opening, will be sunk about 700 feet deeper to the basin. The seams to be cut are eight in number, all workable, including the Mammoth, which, at this place, is about fifty feet thick, and in excellent conditon. It is estimated, also, that the total product of the colliery will reach 35,000,000 to 40,000,000 tons, which, at the rate of 3000 tons daily, will not be exhausted for fifty years,

The cost of the sinking of the shaft, or shafts, building of the breaker and supplying machinery will not fall short of $1,000,000. The breaker alone will cost $300,000. This structure, which is now almost complete, is one of the largest in the whole region. It is 384 feet long, 153 feet wide and 114 feet high. It is supplied with innumerable rolls, screens, jigs and other appliances for preparing coal. This ponderous machinery will be propelled by two eighty-horse power engines, two twenty-inch cylinders and three-foot stroke. The Clark jigs, a device for cleaning coal, however, will be run by independent upright engines, with sixteen-inch cylinders and eighteen-inch stroke.

The hoisting and pumping machinery will consist of four pairs of engines—two for hoisting coal from the shafts, one for lowering and hoisting the workmen, and one to supply coal and timber from the railroad below to the top of the shaft—a fan engine, and at least one pair of large pumps, representing in all about 1500 horse-power. The ventilating fan will be twenty feet in diameter, with eight blades six feet six inches long and five feet wide, and will be driven by an engine with seventeen-inch cylinders and twenty-four inch stroke. The boilers to generate the steam for all this machinery will be three feet in diameter, thirty-two feet long and about forty in number. It is expected that the hoisting and shipping of coal from the first lift will be begun about the 1st of October, but the colliery will not be in full operation for two years.

PNEUMATIC CONVEYOR FOR LETTERS, ETC. Was suggested by Dr. Papin, in 1695; patented by Madhurst in England, 1810, on the compressed air principle, and by Vallance in 1824, on the exhaust principle.

The Growth of London.

The view of the growth of London which was recently presented by Mr. Price Williams to the statistical society covers ground familiar to many of our readers. For the most forcible appeal to the imagination nothing can exceed the mute eloquence of the figures of this preliminary report of the census of 1885. There we learn that at the beginning of the century out of ten inhabitants of England and Wales one lived in London, the proportion has risen to one in seven. The greater London of the register general's weekly returns contained in 1881, 645,818 inhabited houses, built over an area of 697 square miles. The growth of the population over this densely peopled area has been from 3,222,720 in 1861 47.8 per cent. in twenty years, and of 22.6 per cent. in the last decade. Intimately connected with the growth of the population of London, and with the house room provided for their accommodation, is the yet more pretentious growth of the rental, and of the rateable value of the houses. In 1871 the metropolis, then containing, according to the report of the local government board, 417,767 houses, was rated at £19,830,051. In 1881 the corresponding number of houses was 486,286, and the rateable value £27,544,446, showing an advance in the latter of from £47.5 to £56.6 per house. The increase in the total value was thus 38.9 per cent. in ten years, against a growth of 71.23 per cent. of the population. A comparison of this kind shows where lies the nucleus of the difficulty attending the question of the housing of the working classes. And not of the working classes alone, for unless a corresponding activity in trade and manufacture accompanies this apparently irresistible increase in one of the main articles of necessary expenditure poverty must be on the increase. Over the whole of England, after deducting the metropolis, the increase of rateable value has been 28 per cent. in the decade, against 13.84 growth in population. It is conceivable that as this fact becomes known, it may tend to apply some check to the enormous growth of this great realm of brick and mortar.—*The Builder.*

Bisulphide of Carbon in Place of Steam.

Many attempts have been made to use the vapor of bisulphide of carbon for driving engines in place of steam; and we notice from some of the daily papers that the project has been again revived. As this liquid boils at 116°, while water requires a temperature of 212°, it would seem, to one unfamiliar with the law of conservation of energy, that there would be a great saving in fuel by using the bisulphide instead of water. It is capable of mathematical demonstration, however, that there is no gain in so doing, and that an equal weight of fuel will develop the same amount of power, no matter what liquid is used as a means of applying the power. The fallacy of all such schemes lies in considering that the steam or vapor developed in a boiler is the source of the power, when really all the force exerted by an engine is derived from the fuel in the furnace, and the steam or vapor simply serves as a means of conveying it to the pistons and wheels of the machinery. A similar but more palpably absurd claim was made some time ago by an inventor who alleged to have discovered a substance which, if dissolved in the water in the boiler, so lowered its boiling-point that the same quantity of steam could be generated with about one-half the usual consumption of coal. All such schemes are sure to prove failures, and it is not likely that there will ever be found any cheaper method of producing power than by the use of coal and water, although there is still ample room for improvement in increasing the efficiency of our engines and boilers and preventing the great waste of heat which is now unavoidable in the very best of them.—*Popular Science News.*

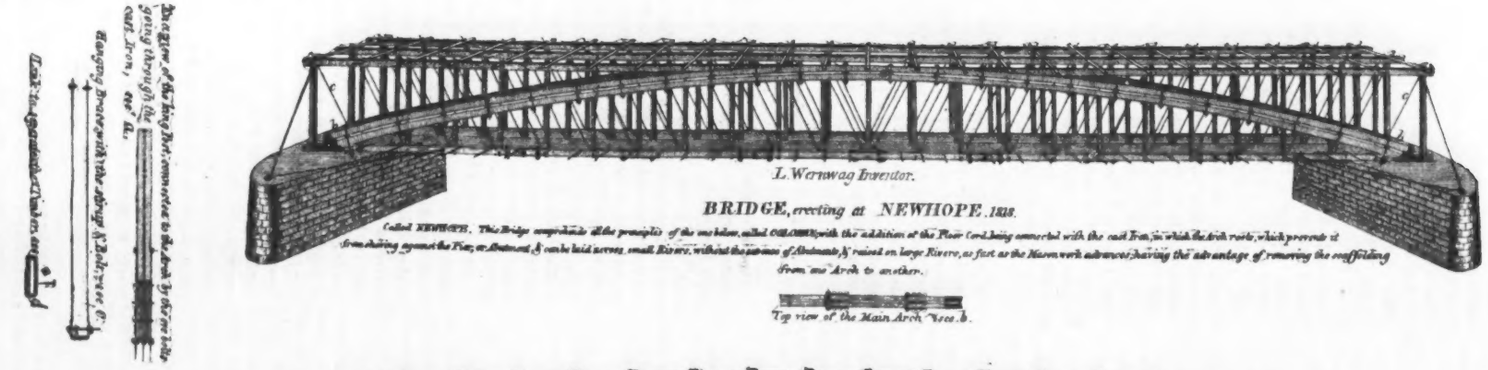
The Actual Death Rate of War.

Some tables have recently been published, based upon a report of the Adjutant General of the U. S. Army, showing the actual per cent. of deaths from sickness and by battle during the war of the rebellion. It is a truism that in war disease kills more than the bullet. The detailed facts showing this, however, in the case of our own war, are of special interest. The States and Territories contributed to the Army of the Union 3,500,000 men. Of these, during the four years of war, there were killed in action 67,030, or 2.88 per cent.; there died of wounds 43,000, or 1.85 per cent., making a total of deaths from violence 110,030, or 4.73 per cent. On the other hand there died from disease 224,586 or 9.68 per cent, disease being thus twice as fatal as the bullet. The total mortality among Union soldiers during the war would be 334,616, or 14.41 per hundred of those engaged. Thus over fourteen out of every hundred soldiers died in the four years' war. This is an enormous death rate, but figures are often wrongly used, and they do not accurately indicate the mortality rightly attributable to the war. The ordinary death rate among male adults is about 9 per thousand annually in this country. During the four years of the war there would have occurred under any circumstances among the three and a half million of soldiers, about 126,000 deaths, leaving, therefore, only somewhat over 200,000 deaths attributable to the war. To put it in a general way, instead of four men who would have died in the natural course of events, fifteen men out of every hundred died in the course of the war. The death rate from bullets is only a little greater than the death rate in civil life, but the soldier has added the enormous risks from disease.—*Medical Record.*

Concrete.

Concrete should be made with Portland cement, with lias lime, or with other equally good hydraulic lime, in the proportions as under. For the best concrete, out of which to mould manhole-inverts or to form sewers, let the proportions be 5 of gravel and sand to 1 of fresh cement or lime by measure. For foundations, backing to side-walls, and coverings to arch spandrels, the proportions may be 7 of gravel and sand to one of fresh cement or lime by measure. Concrete for filling in trenches over sewers and drains, or where required in large masses for foundations, may be made with 9 of gravel and sand to 1 of fresh cement or lime by measure. The gravel may be substituted or be mixed with broken stone, broken tiles, or broken bricks, the largest portions being capable of passing through a ring of 1½ inch in diameter. The sand should be clean, sharp, and in the proportion of 1 to 3 of the gravel. The whole lime, gravel, and sand should be fully mixed in a dry state, and then be wetted by sprinkling with water, preparatory to being placed in the work. Where concrete is substituted for brickwork in retaining-walls, or in walls of tanks and reservoirs, the concrete should be one-third thicker than brickwork—that is, where a retaining wall is required to be 3 feet thick if of brickwork, it should be 4 feet thick if of concrete.—*Sir R. Rawlinson, C. E.*

AIR-PUMP. Hero of Alexandria, the pupil of Otesiphus, who was contempory with Archimides, shows the air-pump in his "Spiritalia." Otto Gueirke, of Magdebury, reinvented and applied the air-pump about A. D. 1650.



L. Wernwag Inventor.

BRIDGE, erecting at NEWHOPE. 1812.

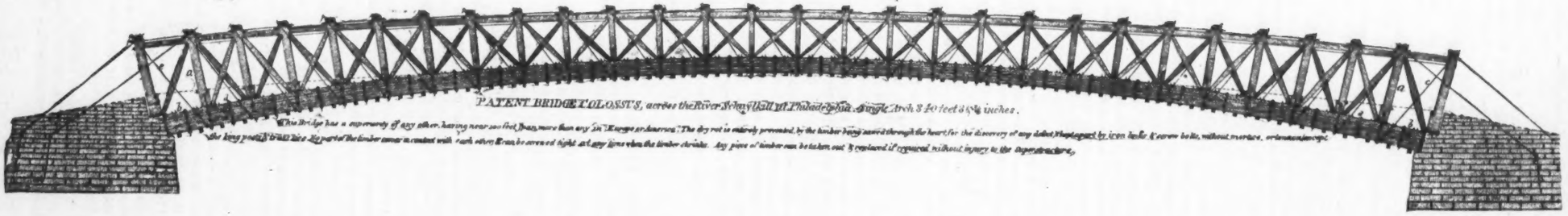
Called NEWHOPE. This Bridge comprehends all the principles of the one below, called COLOSSUS, with the addition of the Floor Cord, being connected with the cast Iron, on which the Arch rests, which prevents it from sliding against the Pier, or Abutment, & can be laid across small Rivers, without the intrance of Abutments, & raised on large Rivers, as fast as the Masonwork advances; having the advantage of removing the centreing from one Arch to another.

Top view of the Main Arch. Scale.

Elevation of the King Rod, connected to the Arch by Screws passing through the cast Iron, one of which is shewn at a.

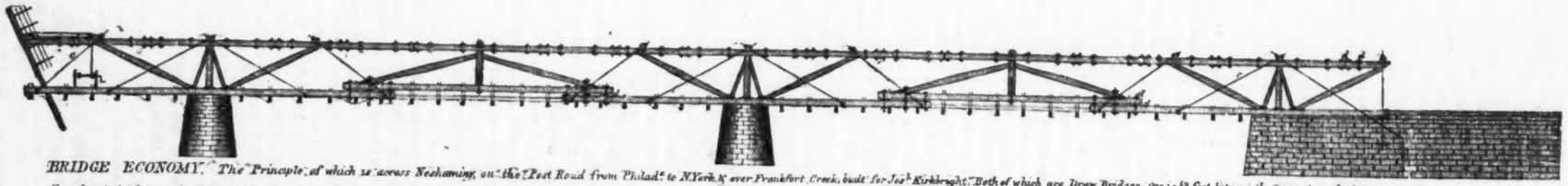
Hanging Brace with the strap & Screws C.

Link to connect the Braces and Rods.



PATENT BRIDGE COLOSSUS, across the River Schuylkill at Philadelphia. Single Arch 340 feet 8 inches.

This Bridge has a superiority of any other, having near 100 feet span more than any in Europe or America. The dry rot is entirely prevented, by the timber being saved through the heart; for the discovery of any defect, that against by iron bolts & screw bolts, without mortice, or tenon timber, the king posts will take 1/4 part of the timber away in contact with each other. Iron to be screwed tight at any time when the timber shrinks. Any piece of timber can be taken out & replaced if required, without injury to the superstructure.



BRIDGE ECONOMY. The Principle, of which is across Neshaminy, on the Post Road from Philad.a to N.York & over Frankfort Creek, built for Jos.h Kirkbright. Both of which are Draw Bridges. One is 52 feet between the Piers, where the Draw is, the other 60 feet between the Abutments. By this means the Navigation is not obstructed, as it has been by Bridges built on former Principles. The Span of this Principle can be extended with or without a Draw, from 120, to 300 feet; having all the advantages of the Colossus & Newhope Bridges, with respect to durability, & for simplicity, strength & cheapness, is exceeded by none. Any Individual or Companies can be accomodated with a Patent Right, on liberal terms, with ample directions for building on either of the above Principles, by application to the Patentee, at the Phenix Nail Works Chester County, State of Pennsylvania.

Lewis Wernwag

BRIDGE DESIGNS BY LEWIS WERNWAG.

Lewis Wernwag, the Bridge Builder.

In nearly every work treating of the rise and progress of modern bridge construction the name or Lewis Wernwag appears as the designer and successful builder of a wooden arched truss of what was then an unprecedented span. But of this pioneer in an art that has made American engineers famed for daring construction, little more is generally known than the one incident referred to, and it is a pleasant duty therefor to add what we can to the meagre store of knowledge concerning a man who would probably have made his mark in any time.

For this reason we reproduce in the present issue, from a scarce old engraving, a plan showing three of Wernwag's designs for bridges; and also publish a letter from his son, written to Samuel L. Smedley, Esq., Chief Engineer and Surveyor of Philadelphia, to whose courtesy we are indebted for its use.

The central design shows the patent bridge Colossus, better known as the Upper Ferry, or Schuylkill Bridge, it having at one time occupied the site of the present Callowhill street bridge in Philadelphia. The company which built it was organized in 1810 with a capital of $40,000; the corner stone was laid April 28, 1812 with impressive Masonic ceremonies, and on Sept. 1, 1838, the bridge was completely destroyed by fire. The bridge had a clear span of 340 feet, 3¾ inches, which in 1812 exceeded by nearly 100 feet the greatest existing span in Europe or America, and would attract attention even in this day of bold undertakings. The design is sufficiently shown on the plan annexed, so that further description is unnecessary.

The upper bridge in the illustration is the bridge built across the Delaware River near Newhope, Penna., and was completed on Sept. 12, 1814, according to a report of the managers of that bridge published in the Proceedings of the Engineers' Club of Philadelphia, Vol. III. page 179. The bridge company was incorporated Dec. 22, 1812, and in Feb. 1813, a contract was concluded with Lewis Wernwag, Joseph Johnson and Samuel Stackers, to complete the bridge upon Mr. Wernwag's plan for $50,000, without covering. The superstructure of this Newhope Bridge consisted of six equal arched-truss spans of 175 feet each; the versed sine of the arch was 13 feet, and each of the three arch segments was made of four ribs of timber, each 6 by 15 inches, dressed to the curve and confined by strong clamps and screw bolts. Iron collars one inch thick prevented contact between the ribs making the depth of the compound arch 13 inches at the crown, and the width of the arch 31 inches at the spring and slightly less at the center. The rectangular truss shown on the plan was intended simply to carry the roadway and the covering of the bridge. The entire width of the bridge was 32 feet, divided into two wagonways and two foot-ways

In building this bridge Mr. Wernwag, as in his other bridges, sawed all the timbers through the heart, so as to detect unsound wood, and to reduce the greatest width of a stick to six inches; the iron collars introduced between the various parts of the rib were to allow a free circulation of air, and thus prevent decay. If greater strength were required the number, but not the dimensions of the sticks, was increased. The bottom chord, however of the truss was framed, so as to act in tension, and thus avoid any horizontal thrust upon the piers.

The bridge "Economy," the third design in the illustrations, is worthy of something more than passing notice. It is a cantilever, of the most radical type, for in one of the spans the designer boldly removes or lifts the center panel whenever he wishes to pass masted vessels through his bridge. The spans are short, but the principle is there, and the bridge was actually built in 1810, and used for years. Wernwag claims that this principle can be extended to spans of 120 to 150 feet, and in the late controversy as to priority of use of the cantilever system in the United States, his claims and his work seem to have been entirely ignored.

The following is the letter of his son referred to, and it is published for the better preservation of some of the details given therein.

HARPERS FERRY, Aug. 27, 1874.

SAMUEL L. SMEDLEY, ESQ.,

Dear Sir: Your letter came to hand enclosing a paper giving an account of the Upper Ferry Bridge built by my father in 1812. Your letter also propounds several questions in relation to that bridge, all of which I endeavor to answer, as far as I am able, at the same time I must state that I have not now any record of my father's transactions, all of which was lost in the terrible flood of '70 in the Shenandoah river. Therefore, if there should be any inaccuracies in the statement I make, it must be attributed solely to my memory.

In reply to your first question I will state that my father was born in Reidlengen, in Germany, and died at Harpers Ferry, Va., the 12th day of August, 1813, aged 73 years, 8 months and 8 days.

2nd. There is not now any model of that bridge in existence, as far as I know. I will therefore refer you to a letter I have written to Thos. Weinway in which I have given all the facts connected with the fate of that model.

3rd. I believe I had all the drawings and plans of bridges, mills and other structures, from the beginning of the present century to the day of his death, but all was lost in the flood of '70.

In regard to the Upper Ferry Bridge, you know that the eastern abutment was fastened on the rock but the western abutment was not, it was built on piles. There was first laid down a platform of logs three or four deep, which was so framed and tacked together as to form openings about a foot square, through which the piles were driven. The managers stated in their report at the completion of the bridge, that 499 piles were driven. I will also state that the piles were driven to the rock, and at the front of the abutment were 30 feet long, and at the end of the platform only about 15 feet. You can therefore judge what an inclined plane the abutment rested on. There is another fact connected with this abutment which probably no one now living knows as well as myself, which is this; when the abutment was filled in to grade the road to the entrance of the bridge, the pressure was so great as to force out the mud through the piles, so as to form an embankment in front of the abutment above high water mark. This pressure caused one side of the abutment to move further out into the river heaving the arch up and making it higher on one side in the center. To remedy this my father had the filling taken out and replaced with stone, and then went to work and cut away the stone behind the heels of the two ribs that were high in the center and let them back to their proper position. I will also state in reference to this abutment, that in order to avoid piling my father proposed to the managers to make the arch 400 feet, which would place the western abutment on the rock, but they would not consent.

4th. There is no engraving of the bridge in my possession, all were lost, but you will find in Reese's Encyclopaedia an engraving of the three plans he built on.

5th. No drawings of the foundation, but a model was made showing the plan as I have described in No. 3.

6th. I have no knowledge of the contract price, only from the paper you sent me.

7th. My father built his first bridge across the Neshamnony on the Frankford and Bristol turnpike in 1810; in 1811 he built a draw-bridge at Bridesburg across the Frankford creek; 1812 the bridge at the Upper Ferry; in 1813 and 1814 the bridge at Newhope on the Delaware; in 1815 and 1816, the bridge at Reading; in 1816 he contracted for the Monongahela and Allegheny bridges at Pittsburg, in 1817 the bridge at Wilkesbarre and one at the Falls of Schuylkill, and 5 miles of canal in Schuylkill County; in 1818 contracted for the bridge at Connewingo on the Susquehanna, and one at Jones' Falls, Baltimore; in 1820-21 he put up the bridge on the Brandywine near Wilmington; in 1822-23 the bridge at Paulings Ford on the Schuylkill, and rebuilt a pile bridge on the Choptank River, and contracted for the bridge at Harper's Ferry, to which place he moved in 1824. While engaged at this bridge he put up one on Goose Creek, Loudon County, Va., also one on the Gunpowder. During the years from 1827 to 1830 he built the bridge across the Manoguay, near Frederick City, and also rebuilt the bridge at Port Deposit, part of which was destroyed by fire; also one at Cambridge, O., on the National road; in 1830 he built the railroad bridge at Manoguay for the B. & O. Railroad, and contracted for the bridge across the Kentucky River and several smaller ones on the Maysville turnpike, and one in Indiana, which he gave to his sons Lewis and William; in 1834 and 35 he built the bridge at Romney across the south branch of the Potomac, and a smaller one on this side of it; in 1836 he built the railroad bridge across the Canal and Potomac at Harper's Ferry. This was the last of his labors as a bridge builder.

8th. I believe from the statement I have made of his labors during the period mentioned, you will be able to form a correct idea of his talents as an architect and builder.

In reference to your request to give you an account of the early days of my father, I must state that I am not prepared at the present time to do so, but when I have more leisure I will give you a sketch of his younger days and the facts and incidents connected with the cause of his being compelled to leave his native country. More than twenty years have passed away since I wrote a sketch of his life, as he narrated it from time to time to his family. I loaned it to a friend at the time the war broke out; he died soon after, and the sketch was lost.

9th. I saw the procession as it passed over the floating bridge to lay the corner stone, but did not witness the ceremonies as the crowd of people was very large around the excavation where the stone was laid.

10th. There are only two members of our family; viz: Joseph P. Shannon, of Baltimore, and my brother Lewis of Lexington, Mo., but whether they can give you any additional information I am unable to say.

11. I have no other knowledge of the fire, but what was published in the papers soon after it occurred.

I will now relate an incident that occurred at the completion of the Upper Ferry Bridge, which I think ought not to be lost, but I must defer the narration to state that reports had been circulated as coming from men of well known standing and ability as architects and builders, that the bridge would not stand, and that as soon as the scaffold was taken from under it, it would crush together and fall into the river. This report spread far and wide, and was the cause of thousands assembling on the banks of the river to see it fall. The morning of the eventful day arrived. The managers had assembled on the porch of Sheridan's tavern discussing (no doubt) what would be the fate of the bridge. When my father approached them the first salutation was "Well, Lewis, do you think our bridge will stand the test to-day?" his reply was: "Yes, gentlemen, it will," and requested them to go on the bridge with him: they did so. When they came to the first set of blocks and wedges on which the arch had rested, he requested one of the managers to examine them. After doing so he replied "they are all loose." The next set was found in the same condition. Thus they went on until the whole were examined and the bridge was found to be clear of the tresselling and the arch resting on its abutments. My father in relating the incident to me said he never saw the countenances of men brighten up as those of the managers when he informed them that the bridge was freed from the scaffold the day before, thus proving to them its stability and putting to silence the reports concerning it forever.

The bridge was a strong one and has stood a heavy test. William Wolf, a teamster who hauled marble to Philadelphia, told me that he hauled a stone over the bridge weighing 22 tons with 16 horses attached to a double wagon. This was the brag of the day, the stone being quarried out for that express purpose.

I have now given you a short sketch of my father's labors with a few exceptions from 1810 to '36, altogether from memory. As I stated in the beginning of this letter, I will again repeat that all his books, papers, draughts, plans, reports of managers of the different bridges he built, and other valuable papers that were in my possession was lost in the flood of 1870. Could I have had them to refer to I would have been able to have made the above statement more full and satisfactory.

Respectfully yours,

JOHN WERNWAG.

COST OF THE BARTHOLDI STATUE.—Work on the pedestal of the Statue of Liberty on Bedloe's Island has been stopped several days, on account of the delay in getting the steel anchors and girders which are to be built into the masonry. General Stone is preparing a memorandum of expenditures up to the present time. The $100,000 which the New York *World* is raising will not be sufficient to complete the pedestal, and an extra amount will be necessary to place the statue in position. The steel anchors and girders will cost $14,000, $4,000 was spent in unloading the statue from the Isere, $350 was the cost of transporting the statue to the fort and it required $600 to build a shed to protect it from the weather. The steel anchors are to be placed at the bottom of the masonry, and will be connected with the girders at the top by long steel rods. This will be done to give the requisite elasticity to overcome the force of the wind. No estimate has yet been made of the cost of putting the statue on the pedestal.

ANEROID BAROMETER invented by M. Vidi, of France.

"The Gauging of Flowing Water."*

BY HENRY TUDSBURY TURNER, STUD. INST. C. E.

The degree of precision with which flowing water can be measured, is not such as to suggest an inference that the science of hydrodynamics is in a highly satisfactory state. Yet, in the practical questions into which these measurements enter as factors, this inaccuracy is small in comparison with the uncertainty regarding the other physical phenomena, which equally affect their solution. It is the author's object briefly to review the methods used by engineers to estimate this important quantity.

The two general conditions under which water has to be gauged are:

First, when flowing from a state of rest in a pond through an artificial notch.

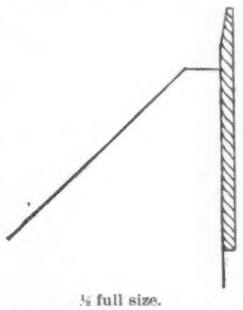
Secondly, when flowing in rivers where the stream is greatly disturbed owing to the roughness of the bed.

The unit of measurement commonly employed is the cubic foot discharged per second of time, though for convenience results are often expressed in such derived units as "million gallons per twenty-four hours."

Notch-gauging, the commonest of all methods of measurement, from the simplicity of the apparatus, observation, and calculation necessary, is applied to ascertaining the flow from a still pond or reservoir, the dimensions of which must be so large relatively to the volume being discharged by the notch, that the water in the neighborhood of the exit may be in a sensibly statical condition.

The form of overfall notch is either rectangular or V-shaped. The plate, usually of metal, which forms the edge of the notch, should be 3 or 4 inches wide, smooth on the up-stream face, and bevelled away at the edges on the down-stream face, so as to present a fairly sharp edge to the flowing stream. The weir, in which the plate is fixed vertically, and on the up-stream side, should extend beyond each end of the notch for a distance not less than three times the greatest height of water proposed to be passed over the notch sill, and the depth of water below the sill should also not be less than this. Another important feature is that the surface of the pond on the down-stream side of the notch, into which the water discharges, should be sufficiently below the sill to avoid reduction of the atmospheric pressure on the under side of the stream, through the closing in of the ends and exhausting action of the flowing water.

FIG. 1.



½ full size.
OVERFALL NOTCH, LIVERPOOL WATERWORKS.

Fig. 1 shows an example of such a notch-sill. The above precautions are essential to accurate notch-gauging, to ensure uniformity of the flow. For its estimation by this method depends mainly upon the results of previous experiment made under such conditions, and it is therefore necessary to observe similarity of conditions in the practical cases to which these results are to be applied.

The rectangular form of notch is used for measuring a fairly constant flow, and the V notch for small and variable flows. In both cases the discharge is the product of the area of the stream in the plane of the notch into its mean velocity past that plane: or $Q = AV$.

For the rectangular notch, the ordinary expression for Q, the rate of discharge in cubic feet per second, is

$$Q = C\, l\, h^{\frac{3}{2}},$$

Where l is the length of notch;
" h is the height of still-water surface above the notch-sill;
And C is a co-efficient determined by experiment.

The truth of the expression depends upon a proper value being assigned to C, to ascertain which many careful experiments have been made. An examination of these shows a striking coincidence in their results when applied to precisely similar conditions, and a general variation of C as $\frac{l}{h}$.

That this coefficient should be some function of $\frac{l}{h}$, would appear evident from the consideration, that whilst the influence of the ends of the notch, termed end contractions, upon the discharge depend in some manner upon h, their effect relatively to the total discharge must vary inversely as l. The author, however, finds but few traces of efforts having been made to practically determine the variation of the coefficient upon this basis.

But, although the phenomenon has been noticed both by experimenters and by those who have deduced rules for practical use from their results, it has been customary to obtain from each series of experiments a mean

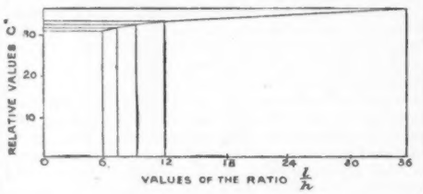


FIG. 2.

coefficient; and as the investigators have chiefly confined their experiments to short notches, with consequently but a small range in the values of $\frac{l}{h}$, these mean coefficients do not widely differ from one another.

TABLE I.—MEAN COEFFICIENTS OF VARIOUS EXPERIMENTERS.

Name.	Mean value of C
Dubuat	3.38
Eytelwein	3.40
Bidone	3.32
Poncelet and Lesbros	3.23
Brindley and Smeaton	3.41
Blackwell	3.37

Now, although most of the above means do not differ very much from any of the actual values of C in each series, when the ratio $\frac{l}{h}$ becomes much greater than its average value in the experimental cases, a serious error is introduced by taking C constant. This, in fact, amounts to the diminution of discharge owing to end contraction, repeated as many times as the length of the notch under consideration is a multiple of that of the experimental notch. Fig. 2 shows the variation of C depending on the value of $\frac{l}{h}$ plotted from the experiments of Mr. T. E. Blackwell in 1850.[1]

From the form of the curve it might be inferred, that an extension of the experiments to higher values of $\frac{l}{h}$ would result in higher values of C being obtained: and Mr. Blackwells's other experiments on a 10 feet notch confirm this view. He, however, suggested for practical use the mean value C = 3.380 for a 3 feet notch, and C = 3.570 for a 10 feet notch.

Mr. Francis the author of the "Lowell Hydraulic Experiments," has, in formulating the results of his work, avoided the difficulty of introducing a variable coefficient, by making the effect of end contraction a deduction from the full discharge, dependent only upon h, and specifying that the length of the notch shall be always so great in proportion to the head, that the influence of end contraction shall not be sensible to a greater distance from either end than to the center of the flow.

His experiments, carried out in 1853, were on the most extensive and practical scale till then attempted, and every care was taken to make the experimental conditions as nearly as possible those above mentioned as constituting the desiderata of good notch-gauging apparatus.

Mr. Francis' formula, for values of h between 2 feet and 0.5 foot is

$$Q = 3.33\,(l - n\,0.1\,h)\,h^{\frac{3}{2}},$$

Where n = the number of end contractions. (In the present case two.)

And provided that the ratio $\frac{l}{h}$ never becomes less than 3.

His experiments did not extend to this last-mentioned condition, and the author questions the propriety of applying the formula to such a low value of $\frac{l}{h}$. In support of this view Fig. 3 has been prepared, which shows the velocity-curve across an 8 feet rectangular notch under a head of 0.5 foot.

The velocities were measured with an accurately-rated electric current-meter, whose fan traversed the plane of the notch, clearing the sill by about ¼ inch, and being just covered by the water.

It will be observed that the velocities appear generally higher on the left than on the right of the figure. This is attributable to the assistance received by the fan which was a left-hand one, from the side-flow near the left end of the notch, and the resistance to turning experienced near the right end, owing to the velocity being greater in the lower than in the upper half of the depth.

But none the less striking is the appearance of diminished velocity near each end of the notch, and it may certainly be taken as extending for a distance of 1.5 foot into the flow

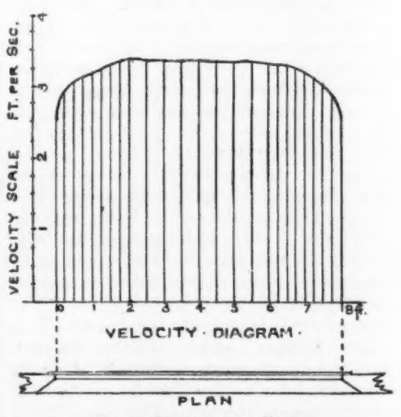


FIG. 3.—RECTANGULAR NOTCH.

from each end. That is, the total length of notch sensibly affected by end contraction under 0.5 foot head is 3 feet, or six times the head.

The Author would here draw attention to the "coefficients of efflux" determined by Messrs. Poncelet and Lesbros, which show that the rate of increase of the coefficient diminishes markedly as the value of $\frac{l}{h}$ passes from 5 to 8. And because in every similar notch the conditions of flow are similarly affected, this value $\frac{l}{h} = 6$, as the least allow-

*From the Proceedings of the Institution of Civil Engineers.

[1] Minutes of Proceedings Inst. C. E. vol. x., p. 331.

able, holds for all notches of like character, no matter what value be assigned to h. With these restrictions Francis' formula must be accepted as the most reliable under ordinary practical conditions yet published.

For long notches discharging under small heads, where the value of $\frac{l}{h}$ is greater than 20, there is, excepting Mr. Blackwell's experiment before referred to, no published record of investigation upon the necessary scale to be of use in determining a true expression for discharge.

Comparing Mr. Blackwell's measurement of the discharge over a 10-feet notch under a head of 0.16 foot with that given by the old expression $Q = C\,l\,h^{\frac{3}{2}}$, where the adopted value of C is 3.34, the average of the six mean coefficients before noted, it appears that

Q measured by Blackwell = 2.91 cu. ft. per sec.

Q by formula $3.34\,l\,h^{\frac{3}{2}} = 2.34$ " " "

That is, the discharge calculated by the formula falls short of the truth by more than 20 per cent. in this instance. And if the notch were longer, the comparison would be still more unfavorable to the formula.

To meet this difficulty the author suggests an expression derived from the following investigation: Taking the results of Mr. Francis' experiments upon a 10-feet notch, he reduces them to the discharges of a 3-feet notch under precisely similar conditions of head, and compares these latter quantities with those measured by Mr. Blackwell over a 3-feet notch.

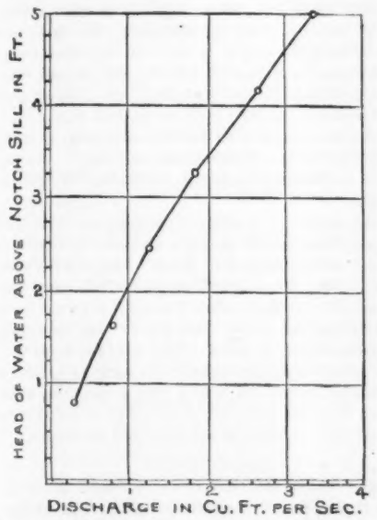


FIG. 4. 3-FEET RECTANGULAR NOTCH. DISCHARGE CURVE.

The following table shows this comparison:

TABLE 2.

Francis' Experiment.			Reductions to Discharge over 3-feet Notch.			Blackwell's Measurement of Discharge (3-feet Notch.)
Length of Notch.	Head.	Q.	Length of Notch.	Head	Q.	
Feet.	Foot.	Cu. Ft. per second	Feet.	Foot.	Cu. Ft. per second	Cu. Feet per second
10	1.5	59.95	3	0.45	2.92	2.91
"	1.0	32.60	"	0.30	1.61	1.64
"	0.8	23.40	"	0.24	1.15	1.18
"	0.7	19.20	"	0.21	0.95	0.97
"	0.6	15.30	"	0.18	0.75	0.78
"	0.5	11.70	"	0.15	0.58	0.60

NOTE.—The values of Q in the last column are obtained from the discharge curve, Fig. 4, which is drawn through the points determined by Mr. Blackwell's experiments.

The reduction is effected by multiplying Francis' results by $\left(\frac{3}{10}\right)^{\frac{3}{2}}$, according to the method enunciated by Professor J. Thompson. The close coincidence of the two series of results in the sixth and seventh columns of the table affords evidence of the accuracy of the gaugings.

Fig. 4 exhibits the curve corresponding with Mr. Blackwell's measurements. It is of parabolic form. Turning to Mr. Blackwell's experiments on a 10 feet notch, the results of which are shows in Fig. 5, by open circles, the positions of certain of them appear erratic. For, all reasoning in hydro-dynamics, supported by the best experiment, goes to show that such a discharge-curve must be parabolic, which would not be the case here were the curve traced through all the experimental points.

But applying the method previously noticed, and reasoning from the lower quantities discharged by a 3 inch notch to those which a 10 feet notch would discharge under similar conditions of head, the results obtained enable a very fair discharge curve to be drawn. These results are summarised in Table III:—

TABLE III.

Discharge of a 3-feet Notch obtained from Equation.		Discharge of a 10 feet Notch under similar Head.		10 Feet Notch. Blackwell's Measurement under this Head.	10 feet Notch. Discharge by Formula, D'Aubuisson.	10 feet Notch Discharge by Formula Poncelet.
Head.	Q.	Head.	Q.			
Foot.	Cu. Feet per second.	Foot.	Cu. Ft. per second	Cu. Ft. per second	Cu. Ft. per second	Cu. Ft. per second
..	..	0.083	..	1.04	..	..
..	..	0.16	..	2.92	..	..
0.083	0.260	0.277	5.27	..	..	..
0.100	0.340	0.3	6.89	6.76	..	..
0.125	0.468	0.417	9.49	9.36	..	..
0.150	0.607	0.5	12.29	..	12.31	12.04

Column 4 gives values of Q obtained as described, their positions in the diagram being marked by black dots. Column 5 gives for comparisons the available direct measurements on a 10 feet notch (Blackwell's.) Columns 6 and 7 give values of Q under a head of 0.5 foot according to the ordinary formula, using respectively D'Aubuisson's and Poncelet's values of C for this ratio of length to height, being the only other available determination of the coefficient for so high a ratio.

The equation to the discharge curve in Fig. 4 is:

$$Q = 9\,13\,h^{\frac{10}{7}} \qquad \text{(i.)}$$

And to that in Fig. 5 is very nearly—

$$Q = 33.15\,h^{\frac{10}{7}} \qquad \text{(ii.)}$$

From the value of Q for any head on the 10-feet notch (up to $h = 0.5$ foot) deduct the value of Q for the same head on the 3-feet notch. One-seventh of this difference is the discharge per lineal foot of the middle portion of the 10-feet notch not affected sensibly by end contraction.

Thus Q per lineal foot of notch unaffected by end contraction is,

$$\left(\frac{33.15 - 9.13}{7}\right)h^{\frac{10}{7}} = 3.43\,h^{\frac{10}{7}} \qquad \text{(iii.)}$$

Combining (i.) and (iii.), however the length of notch be increased for the low heads under consideration (*i.e.*, h less than 0.5 foot), and when l is not less than 3 feet,

$$Q = (l - 3)\,3.43\,h^{\frac{10}{7}} \times 9.13\,h^{\frac{10}{7}},$$

cubic feet discharged per second,

$$= 3.43\,(l - 0.34)\,h^{\frac{10}{7}}.$$

As evidence of the accuracy of the formula the author submits the results of three experiments on an 8-feet notch in Table IV:

TABLE IV.

Head.	Measured Discharge over an 8-feet Overfall Notch.	By Formula. $Q = 3.43\,(l - 0.34)\,h^{\frac{10}{7}}$.	By Formula. $Q = 3.34\,l\,h^{\frac{3}{2}}$.
Foot.	Cu. ft. per second.	Cub. feet per second.	Cubic feet per second.
0.563	11.32	11.56	11.29
0.5	9.87	9.88	9.43
0.354	6.09	5.96	5.64

Column 4 shows the deficiency caused by the use of the mean coefficient in this case of high values of $\frac{l}{h}$.

The author regrets his inability to extend the comparison to lower values of h, but the object for which the experiments were made did not allow of this. The same feature of error in defect, through the use of a mean coefficient, increasing with the value of $\frac{l}{h}$, is however, noticeable here as previously, and cannot be far short of 20 per cent. when $h = 0.2$ foot.

The quantities discharged were computed from velocity observations made in a straight and uniform brick channel, that carries the water from the Lower Rivington reservoir to the still pond above the notch. An accurately-rated electric current-meter was used, and each experiment comprised a series of twenty velocity measurements in a cross-section of about 13 square feet. The readings of the meter were taken twice at each point, and before commencing a series it was ascertained that the condition of the channel and pond was permanent.

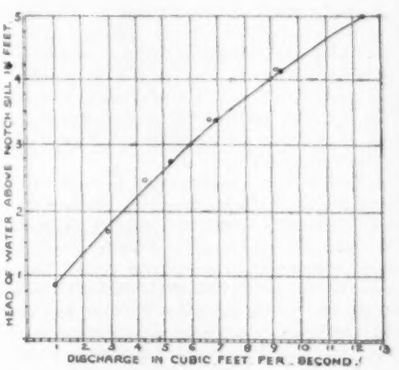


FIG. 5.—10-FEET RECTANGULAR NOTCH, DISCHARGE CURVE.

Gauging with the V notch is not attended with the difficulties in computation attached to the rectangular form, and an accurate expression for the discharge is a matter of ordinary hydraulics.

As an example of the most modern method of accurate river-gauging, the author will briefly describe the operation of gauging the flow of the River Severn, undertaken in the early part of 1880 in connection with the Liverpool Water Act of that year, for obtaining a new supply from the river Vyrnwy, a tributary of the Severn, in North Wales. The site selected was at a point about 1 mile above the Diglis Weir at Worcester, on a straight reach ½ mile in length. The river is here 180 feet wide, and when bankfull is about 25 feet deep in the middle. The section having been accurately levelled, two staffs were fixed on opposite sides of the river with their zero points at the level of the lowest dry-weather flow, and the discharges corresponding with different readings of these staff-gauges were computed from velocity measurements made at each foot of depth below the water surface, past verticals 10 or 20 feet apart in the cross-section. These measurements were made with two of Mr. Deacon's electric current-meters, which before being used, had been rated by Mr. Froude at the Admiralty Testing Works, Torquay. The details of the construction and rating of these instruments have been previously explained.[1] Fig. 6 is a sketch of the apparatus specially constructed for directing the meters to any position in the river section. It consisted of two upright poles, 50 feet in height, placed 240 feet apart on opposite

[1] Minutes of Proceedings Inst. C. E., vol. lxix., p. 397.

sides of the river. Between these poles was stretched tightly a No. 12 steel wire, upon which traversed a small carriage mounted on two 3-inch pulleys; the carriage was moved forwards or backwards by an endless wire passing round pulleys at the head of each pole, and wound upon rollers at the foot of the pole on the east bank. From this carriage was suspended, firmly attached to it by means of jaws, a T-shaped frame of ½-inch iron piping pointing up and down stream, and carrying, at each extremity of the T piece, pulleys, over which passed two other wires attached to a lower bar of the same length as the T piece. These wires were led over a pulley in the carriage to a roller similar to those previously mentioned. The diameters of the rollers were

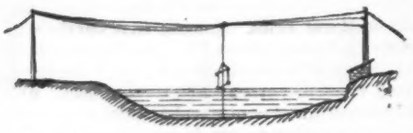


FIG. 6.—RIVER SILWAS, SECTION OF RIVER SHOWING GAUGING TACKLE.

suitably arranged for paying out standard lengths of wire for a given number of turns. The lower bar carried on its up-stream end a socket into which was fixed a short upright rod, and upon this the current-meters were securely clamped, and by means of the above gear they could be brought into any position in the cross-section.

A fourth wire passed over a pulley in the carriage, down the inside of the stem of the T, and through the lower bar, and was attached to a cast-iron anchor-plate weighing 70 pounds which rested on the bed of the river. It was armed on the under side with six 3-inch spikes, and its use was to keep the T frame and lower bar vertically in position during an observation. By means of the last-mentioned wire it was raised when the meters had to be moved on to a fresh vertical. The insulated wires were carried from the meters overhead of the frame T to a shed where the rollers and electrical apparatus were placed, and in which the operators stood.

The method of computing the discharge of the river corresponding with any staff-reading was as follows: The observed velocities past each vertical were plotted to a large scale on a diagram, so as to form velocity-curves at each point whose areas represented the discharges past the respective verticals.

The integration of a complete series of such discharges gave the total corresponding rate of discharge.

Altogether fifteen series of observations were made, and their results were plotted to a curve. From this curve was constructed a discharge-scale, giving the rate, in million gallons per day, corresponding with the staff-guage reading, used for computing the daily flow of the river from the diagrams of an automatic gauge. These are drawn by a pen whose zero coincides with that of the staff-gauges before mentioned, and which has been adopted since 1878.

The gauging of the River Vyrnwy, carried out at the same time, was conducted in a similar manner, but to a higher degree of refinement, the velocity measurements being made at each 6 inches of depth past verticals only 2 feet apart.

The author was engaged in these operations, and he wishes here to acknowledge the kindness of Mr. G. F. Deacon, M. Inst. C. E., who placed the foregoing information at his disposal.

IT is said that Otesiphus of Alexandria, a celebrated mathematical philosopher who lived B. C. 120, constructed an instrument in which air by its elastic force discharged an arrow from a tube. (Montucla, *Histoire des Mathematiques*, vol. I, p. 267).

Contributions to our Knowledge of Sewage.

BY WM. RIPLEY NICHOLS AND C. E. ALLEN.

In the year 1872, one of us had occasion to report[1] the results of the chemical examination of a considerable number of samples of the sewage of Boston and of Worcester, Mass. The examinations then made included the determination of the nitrogen existing as ammonia or in the form of ammoniacal salts (tabulated as free ammonia), and of the nitrogen which was given off as ammonia by treatment with an alkaline solution of permanganate of potash, according to the well-known method of Wanclyn. As indicating the total amount of organic nitrogen, this last determination—that of the so-called "albuminoid ammonia"—was felt at the time to be inadequate, but under the then existing circumstances it was the best that could be done.

When Kjeldahl's process for the determination of the total nitrogen in organic substances was published a few years ago,[2] it suggested itself at once that the method might possibly be conveniently applied to the analysis of sewage. Circumstances have prevented, until recently, the carrying out of this idea; meanwhile, the process has found extensive application, especially in agricultural laboratories, and has been used in the analysis of certain kinds of fertilizers. It is possible that it may have elsewhere been applied to the examination of sewage; if so, we have failed to meet with notice of such application, which we find to be quite practicable and to give satisfactory results.

In order to familiarize ourselves with the process and, at the same time, to become satisfied of its substantial accuracy, determinations of the total nitrogen were made in sulphurea, in dried and powdered horse dung, and in dried and powered human excrement, the amount of nitrogen being checked either by theory or by an absolute determination according to Dumas' method. The results were as follows:

	I. Kjeldahl's method	II. Dumas' method.	III. Theory.
Sulph-urea	36.89 per cent.	.....	36.84
Horse dung 1	3.16 "	3.28	.....
" 2	3.12 "	.....	.....
Excrement	6.20 "	6.08	.....

In order to satisfy ourselves as to the constancy of the results obtained in a number of determinations made on the same sample of actual sewage, a sample was procurred and analyzed with the following results:

Organic Nitrogen Expressed as parts in 100,000.

Kjeldahl (after deducting nitrogen as free ammonia).	Dumas.
3.75	3.66
3.50	.....
3.75	.....
3.70	.....
3.75	.....
3.75	.....
3.80	.....

It thus appears that the process gives uniform results, and that these results are sufficiently accurate for the purpose. It has the advantage of requiring only the ordinary apparatus used in water analysis, as generally conducted in this country, and of avoiding a dry combustion, which, in the simplest form is more or less troublesome, especially where a liquid has to be evaporated, and the solid residue transferred from the evaporating dish.

There is little doubt that the coming decade will see in this country a considerable application of the method of disposing of sewage by irrigation, and it seems to us that Kjeldahl's process will afford a ready means of determining the amount of that important constituent—the combined nitrogen. The process, as we have used it with sewage is as follows:

From 25 to 50 cubic centimeters of sewage are introduced into a small flask, preferably flat bottomed, made acid with sulphuric acid and evaporated to dryness on a water bath. This is best and most rapidly accomplished by drawing through the flask a somewhat rapid current of air which has been freed from moisture and ammonia by bubbling through strong sulphuric acid. We have satisfied ourselves that the loss of "free ammonia" by this treatment is inappreciable so that the residue contains the total combined nitrogen[3] of the sewage. This residue is treated in the flask with 5 cubic centimeters of fuming sulphuric acid which is run in from a glass-stoppered burette. The flask is placed on a piece of wire gauze over a small gas-flame and heated until a light yellowish-brown liquid is obtained. With sewage this result is sometimes reached in half an hour; usually from one to two hours are required. Permanganate of potash is then added to complete the oxidation, a few crystals being sufficient.[4]

The contents of the flask are then washed into the distilling apparatus with about 500 cc. of pure distilled water, enough caustic potash is added to give an alkaline reaction, and the nitrogen, which is now all in the form of ammonia, is distilled off in the usual way. The distillate is made up to 250cc. and aliquot portions are nesslerized as in water analysis. As the sulphuric acid usually contains a trace of nitrogenous compounds, a blank experiment determines a slight correction to be applied.

The process as just given may be modified by evaporating the sewage without first acidulating with sulphuric acid. The evaporated water may be condensed and the free ammonia determined therein and an approximate determination of the total solids may be made by using a tared flask. We prefer, however, to proceed as indicated above and to make a separate determination of free ammonia, with which may be coupled, if desired, a determination of the so-called albuminoid ammonia.

BOSTON SEWAGE.

Since the examinations of sewage made in 1872, the Boston system of sewerage has undergone an entire change. Instead of being discharged from short sewers emptying at intervals along the water-front, the sewage is now collected into one encircling sewer, carried by means of a tunnel to Moon Island and allowed to flow into the outer harbor on an ebb tide.

We have examined a number of samples taken from the pumping station at City Point where the sewage is lifted in order that it may flow through the tunnel to Moon Island. The sewage was received as a rule in a fresh condition; the heavier suspended particles were allowed to subside and no attempt was made to determine their amount. In fact, the determination of suspended matters in small samples is of little value and a more practical idea of their amount could be obtained on a large scale by estimating the amount deposited in the settling tanks. The following table contains the results of the examination of various samples of sewage from the pumping stations. It will be noticed that the samples taken at different times vary very much from each other. The large amount of total solids and chlorine are said to be due to the fact that a considerable quantity of sea-water is used in certain manufactories for

[1] Fourth Annual Report of the State Board of Health of Massachusetts, Boston, 1873. pp. 65-81.

[2] *Fresenius Zeitschrift*, xxii (1883), p. 366; *Chemical News* xlviii (1883), p. 101.

[3] The nitrogen which exists in the sewage as nitrites and nitrates is too small to be of practical importance although there is usually a trace.

[4] For fuller details, see Kjeldahl's original paper, referred to above.

cooling purposes and to the infiltration of salt water into the sewers which are below the tide level.

NITROGEN AS UREA.

The rapidity with which urea is converted into carbonate of ammonia and water in the presence of the urea ferment which is probably always present in sewage, would prevent its existance in stale sewage, but as the Boston sewage reaches the point from which our samples were taken in a fresh condition, we might expect to discover some of this substance still unchanged.

The evidence that urea was present in several samples which were tested is as follows: Two portions of 50 cc. each were boiled in small flasks to expel the free ammonia and to kill any of the ferment present, and the necks of the flasks then stopped with cotton wool. When the contents had become cool one of the flasks was infected by dipping a glass rod first into a fermenting solution of urea, or into stale sewage and then into the boiled sample. The two samples were allowed to stand side by side for several days, and then examined for free ammonia is a similar fashion. In one case the flask which had not been impregnated was free from ammonia, generally, however, a small amount of ammonia had developed itself[a], in all cases the impregnated flasks showed a much greater amount of ammonia than was contained in the companion flasks. This certainly points to the presence of urea or some similar fermentable nitrogenous compound in the sewage as it reaches City Point.

Results expressed in parts in 100,000.

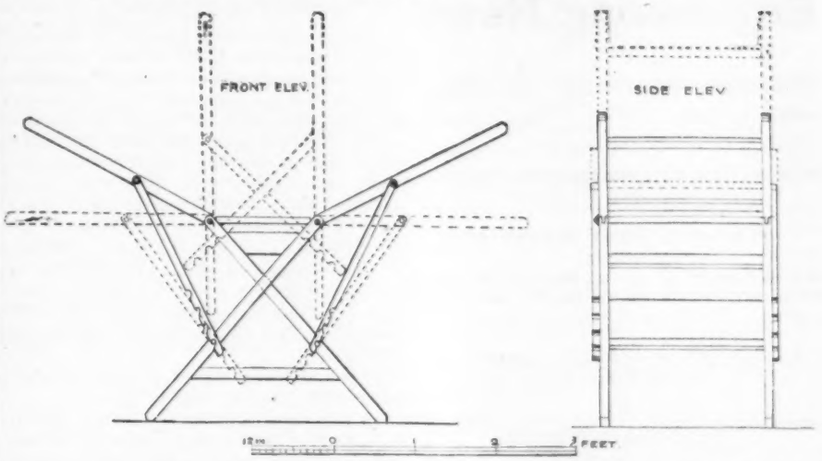
Number.	Date of Collection.	Ammonia.	Albumin-oid Ammonia.	Total Nitrogen, reckoned as Nitrogen.	Ammonia.	Total Solids.	Chlorine.	Chlorine reckoned as common salt.	Phosphoric Acid. (P_2O_5.)
1	1885. May 12, 7.30 P. M.	2.80	0.27	2.80	3.40	592	275	453	0.460
2	13, 8.30 A. M.	3.18	0.44	3.46	4.20	548	258	425	0.096
3	13, 7.30 P. M.	3.42	1.15	5.76	7.00	274	82	135	0.612
4	14, 7.30 A. M.	1.32	0.35	1.81	2.20	570	247	407	0.704
5	15, 1.00 A. M.	1.29	0.67	4.63	5.62	482	133	219	1.343
6	15, 8.15 A. M.	1.59	0.25	6.00	7.30	416	194	320	0.512
7	15, 4.00 P. M.	3.04	0.55	3.76	4.67	356	145	239	0.192
8	16, 7.30 A. M.	0.95	0.56	2.14	2.60	630	311	513	0.288
9	17, 4.25 P. M.	5.68	5.96	14.53	17.65	554	215	354	0.576
10	18, 8.00 A. M.	6.23	5.64	13.82	16.78	528	89	97	6.409
11	24, 7.50 P. M.	11.94	3.33	17.15	20.82	378	179	295	3.325
12	23, 12.40 A. M.	7	2.02	11.32	13.75	460	177	292	0.993
13	26, 12 hour day average†	5.71	3.23	11.39	11.60	640	266	475	4.893
14	27, 12 " average....	3.13	3.31	9.53	11.03	588	240	396	6.188
15	26-29, 24 " average....	2.72	0.73	9.82	.....	89	19	31	4.702
	1872. Average of 33 day samples‖	3.13	5.49	.....	.....	17	4.5	7.4	1.691
	4 night "	1.33	0.23	.....	.....	.....	.....	.....	.....

* Samples 5 and 6 contained a good deal of storm water. † Samples taken every four hours. ‡ Samples taken every two hours. § Samples from sewers near the water front, which evidently contained much sea-water, were not included in these averages. ‖ Average of 19 samples.

In conclusion we desire to acknowledge our indebtedness to the Department of Improved Sewage for facilities in collecting samples, especially to Mr. Barnes, at Chester Park, and to Mr. M. H. Holmes, at the pumping station.

[a] Probably the initial boiling had not expelled the whole of the free ammonia.

PLAN OF ADJUSTABLE STAND FOR FOLIOS OF MAPS.



An Adjustable Stand for Folios of Maps.

The above elevation and side view of a convenient stand for holding folios of maps, is recommended by the Connecticut Society of Civil Engineers and Surveyors. It is convenient, inexpensive, easily constructed and sufficiently explained in the sketch given.

The Purification of the Thames.

Our readers will remember that from time to time we have published accounts of the evidence received, and the conclusions arrived at, by the Royal Commission, which was appointed to inquire into the state of the Thames. It was found that last summer the condition of the water reached a pitch of foulness at which the nuisance became unbearable, and the whole riverside population from Greenwich to Erith was more or less inconvenienced by the stink. Those who had to gain their living on the water suffered actual illness, while the Commissioners themselves were attacked by diarrhœa and vomiting after one of their visits. The state of affairs grew so bad that the Metropolitan Board of Works were obliged to confess that their crowning work was a failure, and sought to whitewash its filth by a plentiful admixture of chloride of lime, which was used to the extent of very many tons a day. All that time the advent of cholera in this country was expected almost day by day, and the calm assurance with which the danger would have been met, owing to the otherwise capital sanitary arrangement of the metropolis, was a good deal shaken by the uncertainty as to what effect the floating mass of filth, regurgitating daily between Blackwall and Erith, might have on the question.

It was too late to do anything last summer, but every one felt that at length the time had come when this crying disgrace would be attacked. But we are again at the end of July and the authorities have made no sign, and to all appearance have forgotten that the Commission ever sat. But while officialism has been dozing or sulking, private enterprise has been at work. Mr. Bailey Denton and Lieutenant-Colonel Alfred S. Jones have acquired more than three-fourths of Canvey Island, a large area of 4000 acres reclaimed from the Thames, and separated from the Essex Marshes by Hole Haven and East Haven Creeks. Here they propose to erect purification works, using the solid matter to raise the ground up to high water mark or higher, and turning out a pure effluent carified by filtration through the land. They estimate that there is space to bestow the solid sewage matter for 100 years, and much additional ground could be obtained by reclamation if needed. Added to the scheme is an offer to take the sewage from the Metropolitan Board, and deal with it satisfactorily for an annual subsidy of 110,000l., or one penny in the pound of the metropolitan rates. At the end of 40 years the whole plant and land is to be handed over to the authorities without further payment. This proposal has been submitted to the Home Secretary, and bears on its face the stamp of earnestness and good faith. whic should secure it a fair consideration.—*Engineering.*

Bill Nye on Modern Architecture.

It may be premature, perhaps, but I desire to suggest to anyone who may be contemplating the erection of a summer residence for me, as a slight testimonial of his high regard for my sterling worth and symmetrical escutcheon—a testimonial more suggestive of earnest admiration and warm personal friendship than of great intrinsic value, etc.—that I hope he will not construct it on the modern plan of mental hallucination and morbid delirium tremens peculiar to recent architecture. Of course, a man ought not to look a gift house in the gable end, but if my friends don't know me any better than to build me a summer cottage and throw in odd windows that nobody else wanted, and then daub it up with colors that they have bought at auction and applied to the house after dark with a shot gun, I think it is time that we had a better understanding. Such a structure does not come within either of the three classes of renaissance. It is neither Florentine, Roman, nor Venetian. Any man can originate such a style of architectrue if he will drink the right kind of whisky long enough, and then describe his feelings to an amanuensis. Imagine the sensation that one of these modern, sawed-off cottages would create a hundred years from now, if it could survive! But that is impossible. The only cheering feature of the whole matter is that these creatures of a disordered imagination must soon pass away, and the bright sunlight of hard horse-sense shine in through the shattered dormers and gables and gnawed-off architecture of the average summer resort. A friend of mine, a few days ago, showed me his new house with much pride. He asked me what I thought of it. I told him I liked it first-rate. Then I went home and wept all night. It was my first falsehood.

AIR-THERMOMETER. Hero in his "Spiritalia," B. C. 150, describes an instrument wherein water is made to rise and fall in a tube by changes of temperature. Its later invention is ascribed to Drebbel, of Holland, about A. D. 1600; to Galileo; and to Santorio of Padua (1561—1636).

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WE notice that *Engineering*, of July 31st., has practically reproduced our article on Petroleum Transportation published June 13th. While the article is rewritten for our London contemporary, the information we gathered at some considerable trouble, and our illustrations are used, and we feel correspondingly flattered. The fact that credit is omitted to this journal is probably due to an editorial slip or to the neglect of the compiler to state source of information. As our publication was the first attempt to show the importance of the enterprise in this country in a connected form, and contained some information never before in print, we naturally want whatever credit is due; only that and nothing more.

PROFESSOR FRANKLAND has lately been experimenting upon the relative efficacy of filtration, agitation with solid particles and precipitation, as means of removing microbes from water.

He found that only greensand, coke, animal charcoal and spongy-iron, among filtering materials, wholly removed the micro-organisms; and they lost this power after one month's use. By agitating one gramme of a substance with 50 c. c. of water for fifteen minutes, a great portion of the organic life was destroyed, and the agitation with coke completely removed them.

Precipitation, by "Clark's process," greatly reduced the number of organisms. Dr. Frankland believes that while it was very difficult to furnish large quantities of water filtered of all micro-organisms, owing to the required continual removal of the filtering material, a large reduction in the number of organisms in water can be secured by numerous simple methods.

Progress by Short Cuts.

This is emphatically an age of progress by "short cuts across lots," to use a homely expression, and a glance over the engineering literature of the day proves that the present is teeming with projects, that in boldness and confidence in man's power over the obstructions that nature has placed for ages in his path, exceed the wildest dreams of a generation or two ago. This fact is especially evident in the radical changes proposed in the commercial routes of the world. Wherever an obstructing neck of land is discovered and the capitalists can figure a profit in time of transit by piercing or crossing it, there we find a scheme under way for the accomplishment of this end.

A brief review of these changes in modern geography shows us, first of all, the short cut from Europe to India by way of Suez, avoiding thousands of miles of dangerous sea travel by way of the Cape of Good Hope. Of like nature is the Panama Canal in its intent, and of lesser importance but in quite the same spirit is the Canal of Corinth.

Ireland is now found to lie in the path of commerce between New York and Liverpool, and a canal is seriously suggested across the center of the Emerald Isle to shorten this route. Manchester is to be made practically a seaport by 36 miles of canal admitting the largest ocean steamer; the St. Petersburg canal is open to traffic, and Bismarck now proposes a canal from the North Sea to the Baltic across the jutting headland occupied by Holstein and its neighors; Copenhagen would be no longer in the direct path of commerce to the Baltic, and the Skagerack and Cattegat only schoolboy's dreams.

But not satisfied with cutting canals, which are as old as the Pharoahs, the present generation, through its Capt. Eads, would boldly transfer the modern 5000-ton ship to a railway with cargo intact; run it out of its element across hundreds of miles of solid land, and again launch it in a far ocean to continue on its way around the world. Tehuantepec is a lusty rival to Panama; and now that the possibilities of the scheme are exhibited by careful and intelligent investigation and the application of sound engineering principles, other projectors enter the field with ship-railways. Already work is reported as commenced upon such a road for the connection of the Bay of Fundy with the Straits of Northumberland in the Canadian Provinces; and another is suggested across Florida for the saving of travel between New York and the Gulf ports.

In the light of the daring engineering work of the last decade, and the radical changes suggested in our commercial routes, who can foretell the outcome of the next very few years to come? Archimedes is here with his lever, and if he has not yet found the fulcrum to move his world, he will in any event give it such a shaking up that the old schoolboy will find his geography at fault.

Report of New York Department of Public Works for Quarter Ending June 30, 1885.

The following is an abstract of the last quarterly report of Rollin M. Squire, Commissioner of Public Works of New York City:

The total expenditure in the department for the si.. months ending June 30, was $1,686,407; 18 Contracts, to the amount of $91,850, were entered into in the quarter, 8 repaving contracts footing up to $67,830.45 of the total amount.

The chief engineer of the Croton aqueduct reports the rainfall of April, May and June last, as being less in the same period than for eighteen years past.

The following table shows the rainfall at the several stations where the rain gauges are kept by the Department:

LOCATION.	April Inches.	May Inches.	June Inches.	Total for Quarter Inches.
Boyd's Corners Reservoir	2.09	2.44	1.19	5.72
South East Reservoir	2.12	1.85	1.18	5.15
Kensico Reservoir	2.98	1.57	0.96	5.51
Croton Dam	2.51	1.87	1.04	5.42
Central Park Reservoirs	2.63	2.15	1.37	6.15

On the 12th of June it became necessary to begin the draughts upon the storage reservoirs and natural lakes in the Croton basin, to supplement the deficiency in the natural flow of the Croton river. The amount of water thus drawn from June 12 to June 30 is as follows:

Boyd's Corners Reservoir	360,000,000 gallons.
South East Reservoir	340,000,000 "
Kensico Reservoir	440,000,000 "
Rye Ponds Reservoir	180,000,000 "
Total	1,320,000,0.0 gallons.

It will be seen that for so brief a period the draughts have been quite large, and that if the drought should continue, the resources for supplying the city with water will be tested to their utmost capacity.

The Commissioner again states that the appropriation for "Repairs and Renewals of Pipes, etc.," is inadequate to provide means for the suppression of water waste: 550 additional water meters have been set, making 12,075 in use on June 30.

The constitutional amendment adopted at the last election, limiting the indebtedness of the city to 10 per cent. upon the assessed valuation of taxable property, has stopped the further issue of Assessment Bonds for local improvements. The construction of necessary sewers, etc., are thereby prevented.

The total revenue paid into the bureau of the Water Register during the quarter was $603,506.

The Henderson Bridge.

The bridge across the Ohio River at Henderson, Ky., was opened to traffic on August 6th, with imposing ceremonies. The following account of this structure is gleaned from the press report announcing the event:

The charter for the bridge was granted by the Kentucky legislature in 1872, the Louisville & Nashville R. R. Co. being its projectors. Work was delayed, however, until the spring of 1882, when active operations were commenced. Contracts for the foundations of the piers were then let to O'Connor & McDonald, but owing to what the company considered delay in the work, this contract was rescinded in Feb. 1884, and the present bridge company undertook its completion.

The structure is 3,200 feet long, including 16 piers, the spans are 250 feet each, excepting the main channel span, which is 725 feet long, 103½ feet above low water and 57 feet above high water. The approaches are by embankments and trestles; the trestlework on the Indiana side being 3 miles long.

Five of the pier foundations are on land, dry at ordinary stages of water, four of these being built on oak piles. Nine piers are founded on wooden caissons sunk by the pneumatic process, resting ultimately some 5 or 6 feet into the shale overlying the sand stone rock at that point. The total material in the caissons was about 1,640,000 feet B. M. of white oak and 225 tons of iron bolts, etc.

The total cost of the bridge and its approaches, to July 1st, is figured at $1,860,000. Frederick W. Vaughan, M. Am. Soc. C. E., is the Chief Engineer of the Henderson Bridge Co., and also President of the Louisville Bridge and Iron Co., and Consulting Engineer of the Louisville & Nashville R. R. Co.

ENGINEERING NEWS Three months for One Dollar.

London Water.

From the last received official report of Sir Francis Bolton, C. E., Official Water Examiner, we find that during June, 1885, the Metropolis of London used an average daily supply of water of 168,361,443 gallons. Of this quantity 86,153,337 gallons came from the Thames and the remainder from other sources.

The number of houses supplied was 693,595; 299,725 houses were on constant supply, and the estimated population supplied within the districts of the water companies was 5,146,785.

The subsiding and storage reservoirs for unfiltered water have an area of 465¼ acres and a capacity of 1,290,100,000 gallons; the filtered water reservoirs number 53 and have a capacity of 160,002,000 gallons. There are 150 engines with an aggregate of 17,215 horse-power; 4132½ miles of mains and 7,689 hydrants. The greatest lift by steam power is 389 feet, in the Lambeth Water Works from the Thames at Molesey, and the greatest head on district supplied is 380 feet, and the least 20 feet, both in the range of the Lambeth Works. There are 97 filter beds with an area of 97¾ acres, and the maximum rate of filtration, per square foot of area in gallons per hour, is 2½ gallons at the Lambeth Works, through 3 feet of Thames sand, 1 foot of shells, etc., and 3 feet of coarse gravel. The usual rate of filtration is 1¾ gallons through about the same depth and composition of filter-bed.

The Metropolitan Railway of Paris.

According to *Le Genie Civil* of July 25, the French government is about to submit to the Chamber of Deputies for their approval, a plan declaring the public utility and demanding the concession, by adjudication, of a metropolitan railway in the city of Paris and its immediate vicinity. The principle features of the proposed plan are as follows:

The system recommended by the government is the one that has already received the approval of the Municipal Council of Paris and the General Council of Bridges and Roads. It consists of a series of underground ways through the central portion of Paris. The system, about 25 miles in length, includes:

1st. A line uniting the Moulineaux railway, at Puteaux, with the Vincennes railway at Reuilly, passing by, or near, the Porte Maillot and *les Places de l'Etoile, de l'Opera, de la Republique* and *de la Bastille*.

2nd. Two lines uniting the first named route with the Auteuil railway; the one near Batignolles, and the other near Porte Maillot.

3d. A line tying the Ceinture railway "of the right bank," at or near La Chapelle, to the Ceinture railway "of the left bank," at or near Gentilly and passing near the central Halles or markets.

4th. A circular line on the left bank uniting at the Place de l'Etoile and near the Boulevard Bourbon with the Puteaux and Reuilly lines, and passing by or near the Trocadero and the railway station of Montparnasse.

The work should be commenced within eight months, and the first line should be opened to traffic within 3 years from the date of the decree; the other lines to be completed in 5 years from the same date. The road would be at once built for double track.

The total cost is estimated at $42,000,000, or about $1,680,000 per mile. The financial scheme proposes that one-third of the capital shall be represented by shares and the other two-thirds in bonds; the latter to be guaranteed by the French government. The rate of the guarantee will be fixed by law, based upon a 5 per cent. sinking fund.

The tariff for passengers will be fixed as follows:—10 centimes per kilometer ($1\frac{85}{100}$ cents for 3280 feet) for 1st. class; 7 centimes for 2nd. class, and 4 centimes for 3d. class: return tickets will be sold at 25 per cent. discount on these figures for ordinary hours, and 50 per cent. discounts during the hours that workmen usually travel.

The Mekarski Street Car Motor in England.

About two years ago experiments were made on a London Tramway with a Mekarski compressed air motor, and the line is shortly to be worked entirely on this system. The cars are four-wheeled, one pair of wheels alone being driven by the machinery, and under the car body are cylindical reservoirs containing enough compressed air for a trip of ten or twelve miles. To the driving wheels are attached a pair of high and low pressure cylinders of eight inch stroke, and to facilitate starting the high pressure air can, if necessary, be used in the low pressure cylinder. In passing from the reservoirs to the cylinders, the air passes through boiling water, and steam of 60 pounds pressure per square inch contained in a "hot-pot" which is charged at the pumping station at the same time as the reservoirs. It is claimed that by this means the air is expanded, and the formation of snow in the cylinders at the exhaust prevented.

The working pressure in the high-pressure cylinder is usually from 120 pounds to 50 pounds per square inch, and can be varied at will by a valve consisting of a piston working in a vessel containing air and water, the bottom of the vessel is an india rubber diaphragm connected to a valve opening against the pressure in the hot-pot. When the piston is forced down into the water by a hand wheel and screw, the diaphragm is pressed downwards and the steam and air allowed to escape from the hot-pot to the cylinder; an automatic arrangement for regulating the pressure is also fitted. Should the car attain an excessive rate of speed, as over ten miles per hour, a governor cuts off the air supply and applies the brakes to all four wheels.

For ordinary purposes the driver controls the machine with a foot brake. With these arrangements a car can be stopped while at full speed, a distance of a little over its own length. The line is two miles in length, through a busy thoroughfare, and has a varied grade and one very sharp curve. The cars weigh six and a half tons empty, and carry thirty-eight passengers. Street cars on the Mekarski system have been working successfully for six years at Nantes, in France.

PERSONAL.

HIMPS M. SMITH, has been appointed Assistant Chief Engineer of the Rome & Carrollton R. R.

GEN. WILLIAM SOOY SMITH & SON, of New York, have the contract for sinking the pneumatic caissons in the Schuylkill River for the bridge on the B. & O. extension into Philadelphia,

COL. WM. M. PATTON, late engineer in charge of the Havre de Grace bridge of the B. & O., is now superintending the sinking of the three caissons for the Schuylkill River East Side railway at Philadelphia, Pa., H. R. TALCOTT is the Resident Engineer on the above road.

EPES RANDOLPH, formerly civil engineer on the A. G. S. Railroad, but more recently General Manager of the Allegheney Iron Mountain Mining Co., at Covington, Va., has been appointed Chief Engineer and General Roadmaster of the Kentucky Central Railroad, with headquarters at Covington, Co.

GEORGE S. MORISON of New York, the well-known bridge builder has gone west over the Northern Pacific. On his way to the coast he will inspect the three great Northern Pacific bridges. Mr. Morison was accompanied by A. Mitchell, formerly assistant chief engineer of the Northern Pacific. Mr. Mitchell will only go as far as the park.

LIEUTENANT GREELY, U. S, Army, has secured a limited extension of leave, and will probably avail himself of an invitation to visit Europe. He is now at his home in Massachusetts, and is said to be in very poor health. It is even said that the condition of his health is such as to prevent his trip to Europe. Officers here however, state that he will doubtless go to Europe and open the meeting of the Geographical Society at Edinburgh, and for this purpose he secured the additional leave.

SAMUEL W. MIFFLIN, one of the pioneers and leaders among American civil engineers, died at his residence, at Wayne Station, Delaware Co., Pa., on July 26, 1885, in the 81st year of his age. His father, Jonathan Mifflin, was connected with Washington's military family during the Revolution and was a personal friend of La Fayette and other prominent men of the period; his mother was Susanna Wright, of the old English Quaker family of the Susquehanna, the founders of Wrightsville and prominent in colonial affairs. He was thus a representative of two of the very oldest directly English families in Pennsylvania. MR. MIFFLIN began his career as an engineer on the old "Columbia Railroad," the parent of the present gigantic corporation known as the Pennsylvania Railroad. Afterwards he held various positions of trust and high professional character on the New York and Erie, the Boston and Portland and the Phila. and Reading and Lebanon Valley railroads. He located and constructed a considerable portion of the Penna. R. R. in the Alleghenies; the famous Horse Shoe Curve and the Summit Tunnel being practically his location. He was for a number of years connected with the main Penna. line in the location and building of numerous branch railroads; his last work in this connection being the location of the Seaboard route to Long Branch. Just after the civil war he was appointed by the U. S. Government Engineer in charge of Harbor Improvements on Lakes Erie and Michigan. His last professional work was the location of a railroad in West Virginia for a Philadelphia company. Among the older members of the engineering profession, MR. MIFFLIN had a well-earned reputation as a locating engineer, few, if any, excelling him in this important branch of the profession. Personally, he was a close and comprehensive thinker, and was possessed of a highly organized mental and spiritual temperament. He achieved a quiet fame in intellectual paths removed from his professional life, and was a warm friend of the oppressed. In the days before the war he personally assisted many a weary slave from the South northward on his way to freedom, and one of the stations on the famous, and now almost forgotten, "underground railroad" was on his farm at Wrightsville, Pa.

Wire Siege Guns.

Siege guns built of wire, says the London *Telegraph*, are the newest description of ordnance for the national service. A very tough steel wire is used, having a breaking strength of 100 tons to the square inch, which is wound over a steel tube as tape may be wound on a reel, being frequently fastened off to secure its cohesion, and so neatly put together as to look like solid metal. An experimental howitzer has been made upon this principle, and passed a satisfactorily proof at the royal arsenal. It has a calibre of 10 inches, but weighs only about 70 hundredweight. In its trial this howitzer threw a shell of 360 pounds, with a charge of 28 pounds, and attained a velocity of 1,000 feet per second—a result which may be compared with two guns of a similar weight, which are at present in the service. One of those is the 8 inch howitzer, which fires a shell of just half the weight—viz., 180 pounds—with a velocity of 950 feet, and the other is the 100 pounder gun of 6.6 calibre, which, with its light shot of 100 pounds, manages to reach a velocity of 1,390 feet per second. The trial weapon seems in no way impared by the strain to which it has been subjected.

An Ordinance Relating to Private Drains.

We are indebted to Chas. E. Chandler, Surveyor and Civil Engineer of Norwich, Conn., for the following ordinance, which may be of interest elsewhere. Criticism and suggested improvements are invited:

AN ORDINANCE RELATING TO PRIVATE DRAINS

Be it ordained by the Court of Common Councils of the City of Norwich:

SEC. 1. The Committee on Streets and the Street Commissioner shall constitute a Board of Sewer Commissioners.

SEC. 2. The Board of Sewer Commissioners shall have power to license as drain layers such persons as shall comply with the provisions of this ordinance.

SEC. 3. The Board of Sewer Commissioners shall have power to grant permission to licensed drain layers to lay private drains and connect them with the public sewers under the conditions hereinafter set forth.

SEC. 4. The Board of Sewer Commissioners shall have power to stop and prevent from discharging into any public sewer any private drain not laid in accordance with their direction, and no person shall open or cause to be opened any private drain which shall be stopped as aforesaid.

SEC. 5. It shall be the duty of the Board of Sewer Commissioners to grant such licenses and permits, under the conditions herein set forth, and to enforce all the provisions of this ordinance.

SEC. 6. The Board of Sewer Commissioners may appoint an Inspector of private drains to whom they may delegate any or all the powers and duties herein mentioned, but the powers and duties thus delegated shall be particularly specified by said board.

SEC. 7. No person shall be licensed as a drain layer unless he shall make written application to the Board of Sewer Commissioners on blanks provided by said board, and shall give satisfactory evidence to said board of his ability and intention to lay private drains in accordance with the rules herein contained nor until he shall have executed and delivered to the Treasurer of said city a bond to the City of Norwich in the sum of —— dollars, with one or more sureties approved by said board, conditioned to indemnify and save harmless the City of Norwich from all damages caused by his acts or omissions in laying private drains, to replace and restore the street surface and pavement over such drains, and to perform all the work according to the rules herein, under the direction and to the acceptance of said board.

SEC. 8. No person not licensed as aforesaid shall make any connection with any public sewer nor lay any drain connected therewith, and every person so licensed shall give personal attention to the work done under his license and shall employ none but competent men.

SEC. 9. No person shall make any connection with any sewer, common drain, catch-basin, or any part of the sewerage works of the City of Norwich, or open any street for the purpose of laying any drain, without the written permission of the Board of Sewer Commissioners.

SEC. 10. All permits to connect with sewers or common drains shall be made upon the express condition that the Board of Sewer Commissioners may at any time before the completion of such work revoke and annul the same, and no party in interest shall have the right to claim damages on account of the revocation of such permit.

SEC. 11. Applications for permits shall be made by the drain layer at least twenty-four hours before the commencement of the work and shall state the name of the owner and the location, street and number of the premises, together with the size and material of the drain and the character of the fixtures with which it is desired to connect.

SEC. 12. Drain layers shall make full written returns to the Board of Sewer Commissioners within forty-eight hours after the completion of the work, giving size, material, location and grade of the whole length of pipes laid and enumerate the fixtures connected therewith.

SEC. 13. No person shall conduct, or cause or suffer to be conducted, any drain discharging other than clean water upon or into any street in which there is a public sewer, or use or maintain any such drain without having the same properly connected with such public sewer.

SEC. 14. No person shall connect any cesspool, privy vault, exhaust from steam engines or blow off from steam boilers with any public sewer, except under such special conditions as shall be prescribed by the Board of Sewer Commissioners.

SEC. 15. No person shall injure, break or remove any part of any man-hole, lamp-hole or catch-basin, or obstruct the opening of any catch-basin, common drain or sewer, or deposit any offal, garbage, dead animal or filth in any man-hole, lamp-hole or catch-basin.

SEC. 16. No clay, cement, vitrified or other pipe except of iron, shall be laid through the foundations or underneath any buildings.

SEC. 17. Any person who shall violate any of the provisions of the foregoing sections of this ordinance shall for every such offense forfeit and pay for the use of this city a fine of not less than ten nor more than one hundred dollars.

SEC. 18. The following rules shall be observed by all drain layers and owners of property in laying any private drain connecting with any common drain or sewer.

RULES.

1. In opening any street or public way, all materials for paving or ballasting shall be removed with the least possible injury or loss, and together with the material excavated from the trenches shall be placed where they will occasion the least practicable inconvenience to the public. As little as possible of the trench shall be dug until the branch is found, unless it is first determined to make a new opening into the sewer. No opening shall be made in any street until at least twenty-four hours' notice has been given to the Board of Sewer Commissioners, stating the time at which it is desired to make such opening.

2. If the Board of Sewer Commissioners or Inspector of Sewers decide to make a new opening into any sewer, the entire work shall be done in presence of said inspector, and reasonable notice shall be given him of the time said opening is desired to be made.

3. The material of the drain shall be good, sound pipe of the size specified in the permit.

4. The pipe shall be laid in straight lines as far as is practicable, and all changes in direction greater than three inches in two feet shall be made with suitable curves.

5. No pipe for the conveyance of sewerage shall be laid on a grade less than one-quarter of an inch to the foot unless special permit be granted therefor.

6. The joints in the pipe shall be made tight by a band of good cement mortar passing entirely around them, and the interior of the pipe shall be left entirely clean and smooth.

7. The ends of all pipes not to be immediately connected with some fixture shall be tightly closed with imperishable material.

8. All pipes left open for the purpose of draining cellars, areas, yards or gardens shall be connected with catch-basins of the form described in the permit.

9. The back-filling around and over drains shall be thoroughly rammed or puddled and the ballast or paving replaced in the best practicable condition.

10. Every opening made in any street shall be carefully fenced in and be night shall be well lighted.

11. If any gas or water pipe, or other pipe or culvert shall come in the way of any drain, the question of passing over or under the same, or raising or lowering it, shall be determined by the Inspector of Drains and not by the property owner or drain layer.

12. Any person who shall violate any of the provisions of the foregoing rules, shall for every such offense forfeit and pay for the use of this city a fine of not less than ten nor more than one hundred dollars.

Railway Employes in Pennsylvania—Their Number, Classes, Pay, etc.

The secretary of internal affairs for the commonwealth of Pennsylvania, says in his recently issued annual report:

The railroads of Pennsylvania employ about 70,000 wage-workers, whose working time is computed by the month. In no other industry in the state is the average wage-worker assured as regular and as full working time as that given to employes in the service of railroad companies: and, as the necessities of the business require the employment of nearly every class of mechanics, a table of wages paid to wage-workers in the employ of railroad companies will show, if the value of full working time be taken into consideration, the highest average wages paid to trainmen, mechanics and laborers.

The average number of railway employes of the various classes last year, in this state is given in a tabular form, the aggregates being as follows: In conducting transportation there were 2,319 clerks, 35 chief telegraph operators, 886 telegraph operators, 1,828 passenger and freight agents, 55 depot masters, 530 general dispatchers and train masters, 550 train dispatchers, 596 passenger conductors, 1,908 freight conductors, 847 passenger brakemen, 6,680 freight breakmen, 263 janitors, 810 watchmen, 520 baggage masters, 545 switch tenders, 158 baggage porters, 53 policemen, 596 gate and flagmen, 35 cleaners, 326 messengers, 80 weighmasters, 4,976 laborers, 12 blacksmiths, 8 blacksmiths' helpers, 1,417 warehousemen, 8 cargo inspectors, and 1,300 employes of all other descriptions.

The number employed by departments connected with maintenance of way are classified as follows: 153 supervisors, 1,371 track foremen, 11,263 trackmen, 53 switchmen, 51 conductors of work trains, 56 flagmen of work trains, 73 brakemen of work trains, 64 pumpers, 40 master carpenters, 105 foremen carpenters, 1,175 carpenters, 50 foremen of laborers, 3,868 laborers, 33 foremen of masons, 15 foremen of quarrymen, 266 quarrymen, 66 blacksmiths, 44 blacksmiths' helpers, 70 painters, 100 telegraph repairers, and 767 employes of all other descriptions.

In connection with motive power, there were 48 master mechanics, 32 general foremen, 380 foremen, 25 road foremen of engines, 239 motive power clerks, 380 engine preparers, 41 assistant engine preparers, 1,128 car inspectors' 466 car cleaners, 9 riggers, 282 watchmen 1,872 machinists, 597 machinists' helpers, 328 machinists' apprentices, 744 blacksmiths, 876 blacksmiths' helpers, 38 blacksmiths' apprentices,—boiler makers,—boiler makers' helpers, 172 turners, 52 turners' helpers, 17 turners' apprentices, 35 coppersmiths, 1,826 carpenters, 42 carpenters' apprentices, 623 carpenter shop laborers, 44 trippers, 493 painters, 16 painters' apprentices, 77 paint shop laborers, 55 oil distributors, 339 coalmen,—grinders, 1,647 laborers, 695 engine cleaners, 195 stationary engineers, 67 stationary firemen, 725 passenger engineers, 710 passenger firemen, 1,382 freight engineers 1,992 freight firemen, 192 distributing engineers, 189 distributing firemen, 415 yard engineers, 425 yard firemen and 2,094 employes of all other classes.

The figures presented relating to the average wages of different classes of employes embrace the following: The average weekly wages of an engine driver at Liverpool and London is $8.60 per week. In Pennsylvania, in 1884, the average monthly wages of passenger engineers was $85.57, and of freight engineers $65.39. The average weekly wages of locomotive firemen at Liverpool and London is $5.25. In Pennsylvania the average monthly wages of passenger firemen is $48.85, and of freight firemen $44.69. In Liverpool and London the average weekly wages of railroad laborers is $3.45. In Pennsylvania the average monthly wages of 4,676 laborers employed in conducting transportation was $33.82, and the average monthly wages of 3,864 laborers employed in maintenance of way was $31.31. In the locomotive department of the northern division of the North Eastern railway company, at Newcastle-on-Tyne, the average weekly wages of blacksmiths is $7.13. In Pennsylvania the average monthly wages of blacksmiths employed by motive power departments was $54.76.

LITERATURE.

Select Plans of Engineering Structures for Railroads and Highways, as Actually Constructed. Dimensions, Cost and Quantities. Vol. I. By RICHARD B. OSBORNE, C E., M. I. C. E. I. Richard B. Osborne & Son, Publishers, Philadelphia, 1885, Oblong folio. Price $6.00

According to the index this volume contains thirty-five plans, of bridges mainly many of them in masonry. They are drawn to scale and include all general working details, and with each structure is given an itemized statement of quantities and cost. While we doubt not that the collection will be useful to the young engineer especially, the item of price per unit would be of more practical value if the *date* of construction in each case was also stated. Some of the bridges illustrated were built years ago, and the knowledge of this fact is an essential item in any study of the cost.

TRADE PUBLICATIONS.

Catalogue No. 4 of the Clayton Air Compressors, Rock Drills and General Mining Machinery. The Clayton Air Compressing Works, Publishers, New York, 1885.

This last catalogue of the above well known company contains considerable new matter relating to the machinery manufactured by this company. The illustrations are numerous and good, the price lists are revised and many new and flattering testimonials added by users of these machines. The field covered is a wide one, and would-be users will do well to consult the document for themselves.

Catalogue "D"; an Illustrated Catalogue and Price List of Presses, Dies, Can-Makers Machinery, and other Sheet Metal Tools. Published by the Ferracute Machine Co., Bridgeton, N. J., 1885.

This is a handsomely printed and fully illustrated catalogue of all kinds of power and foot-presses, and dies for cutting and stamping tin-plate and other thin sheet metals. In the designs of presses shown, strength and solidity are united with beauty of form, well illustrating one of the characteristic features of American-made machinery. One rather unique and useful feature in this catalogue is the appended scale to each illustration showing the relative size between the cut and the actual machine.

Beton, Coignet and Goodridge System of Constructing and Repairing Railway and other structures, with claim of Patents in United States and Canada. JOHN C. GOODRIDGE, JR., Pres., New York Stone Contracting Co., Publisher, 1885.

Aside from its value, as a publication intended to exhibit and advance the interests of a long-tried and well-tested method of repairing and constructing foundations and other structures, this pamphlet has an interest to the engineer and those connected with him. The numerous illustrations of work already executed, showing the condition before and after the application of Mr. Goodridge's method, are very suggestive to those to seeking remedies for like evils. Of the efficiency of beton construction there can be no doubt, but some of the work here exhibited graphically illustrates the wide range of its applicability. Mr. Goodridge has also included in this pamphlet his numerous patents, covering the many ways in which he proposes to use beton. It makes useful and entertaining reading to the engineer.

How and Where the Best Almanac in the World is Made.

Every family in the United States uses an almanac, but few people are cognizant of the immense amount of work required in their preparation. The big volumes called nautical almanacs, published for the use of astronomers and navigators, with their long lines of digits thrown into an order which would delight a Gradgrind, make the brains of the general reader swim as he endeavors to understand them. These big nautical almanacs are the fathers of all the others. The greatest nations of the world now have their own nautical almanacs, and these are made by their respective Governments. That of France has been published longer than any other. The British almanac comes next, dating back to a little before the Revolution, and the German and Spanish next in order.

The American nautical almanac was first issued in 1855, and is now said to be the best almanac published. It contains more valuable information and calculations than any other government almanac, and it holds the highest place among astronomers and navigators. This almanac is made at Washington, and a special department of the navy under Professor Simon Newcomb is devoted to its getting up. It is a book of solid figures, over an inch thick, about eight inches wide and twelve inches long. It contains more than 500 pages, and each page is black with a multitude of carefully arranged figures, each of which represents hours of calculation and sheets of scientific and algebraic study.

The almanac for 1888 is now out, and that for 1889 is being prepared. Twelve scientists, each noted as an astronomer and a mathematician, located in different parts of the country, are almost constantly working upon it. They make their calculations and send them to Washington, and they are here proved before going into the almanac. The title of the book is "The American Ephemeris and Nautical Almanac."

Almanacs were made for years before any government took them up. The old Romans had a sort of almanac, but the first printed almanac was that of George Von Burback, who issued his predictions at Vienna in 1460. In the sixteenth and seventeenth centuries, and they were full of astrology, astronomy and superstition, in addition to their politics. The first American almanac was that of William Bradford, published in 1687. Ben. Franklin's "Poor Richard Almanac" was first issued in 1732, and the American Almanac, which continued its publication up to 1861, was first published in 1728. There are now about 100 almanacs published in the United States. – *"Carp" in the Cleveland Leader.*

Testing the Underground Plan.

WASHINGTON, D. C., July 8.—The Baltimore and Ohio Telegraph Company has made an arrangement with the gentlemen controlling an underground telegraph conduit to make experiments with the conduit in this city. The agreement is that the owners of the patent shall lay a conduit to carry the lines from the main office of the telegraph company to the Baltimore and Ohio Depot. After two years' use, if the company is satisfied with it, it will pay for the conduit and also for the use of it during the two years probation. Officials say that this is a mere experiment and the company is not committed to the use of the conduit unless it proves entirely satisfactory.

All the companies are looking for a good underground system—one which will combine the elements of durability, cheapness and perfect insulation.

The conduit will be laid in a trench. It will consist of layers of fine ashphalt, sand and silicate, between which the wires will be imbedded. Upon boards at the bottom of the trench will be rolled the first layer of asphalt. Over this will be passed a reel stretching along over the soft asphalt as it goes as many naked copper wires as the service may require or the width of the trench will permit.

Upon this layer of wires another layer of asphalt will be rolled, imbedding the wires in the material so that they will be completely protected, and it is claimed the difficulties arising from induction will be reduced to the minimum. The wires will be numbered, and in case any necessity arises for repairing or tapping a wire at any point it can be reached by use of a cold chisel or tools made for the purpose. The work of laying the conduit will, it is expected, be commenced in a few days.—*Cincinnati Commercial Gazette.*

Advance in Fusing and Casting Process.

The Industrial World remarks that just now the attention of builders of heavy machinery, and even of large sizes of guns, is turned with deepest interest, and even with great anxiety, to the advance in the art of fusing or melting the high grade metals, the various qualities or grades of steel of which these heavy pieces are to be made. The progress actually made in this art in this respect is quite sufficient to warrant the fullest expectation that has thus far been entertained of it. The prospect is very clear that, with the daily experience of many foundries in the study and practice of the art of fusing that stubborn, but valuable metal, steel, the day is close at hand when the more compact and massive pieces or parts of all kinds of machinery will be made of is to the great advantage of all concerned. This very important result is due solely to the study and constantly advancing practice of this oldest of all arts in metals, and the improvements made in the apparatus employed. In this respect, the advance from the time of the mediæval workers is simply incredible, and, indeed, the short space of thirty days covers nearly the whole span from the day of a trifling capacity of furnace for melting to the present time, when the limit is rather the power of existing apparatus to move the finished casting.

The St. John's Cantilever Bridge.

The following is a summary of a letter describing this bridge published in the *Boston Journal*:

It is the first *thorough* cantilever bridge built in America. The plans were completed in 1883, and work commenced in September of the same year; the superstructure was built by the Dominion Bridge Co., of Lachine, Ontario.

The bridge is 74 feet 8 inches above high water, and 94 feet 3 inches above low water. The pier at the east end, upon which one of the cantilevers rests, is 90 feet high. The height of the tower of the western cantilever is 84 feet above the pier upon which it stands, and the height of the eastern cantilever is 72 feet. This irregularity was caused by a failure to find a good foundation for a pier on the west side of the river, where it was originally expected to place the same, and, as a result, the main span of the bridge was made about fifty feet longer than the original plans contemplated, and the cantilever upon the west side was enlarged enough to overcome the increased length of the bridge. The present length of the eastern cantilever is 286 feet and 2 inches, the western cantilever, 380 feet 16 inches, and the central span is 143 feet 1 inch long. This gives the bridge the total length of 447 feet over the river between the piers.

The width of the bridge outside of the superstructure is 22 feet, and inside 16 feet. Fifteen hundred tons of steel have been used in the bridge superstructure, the tensile strength of which is about 60,000 pounds per square inch, and its elongation about 30 per cent.

The contract for the bridge superstructure and the grading on the east side was $ 350,000, but changes in the original plan have increased the cost to $400,000. The bridge is built by the St. John Bridge and Railway Co., Thos. R. Jones, president, and Peter S. Archibald, chief engineer. The completion of the bridge will enable the New Brunswick and the Intercolonial railroads to cross the St. John's river and make through connections with the eastern provinces. The new bridge will be formally opened on August 19.

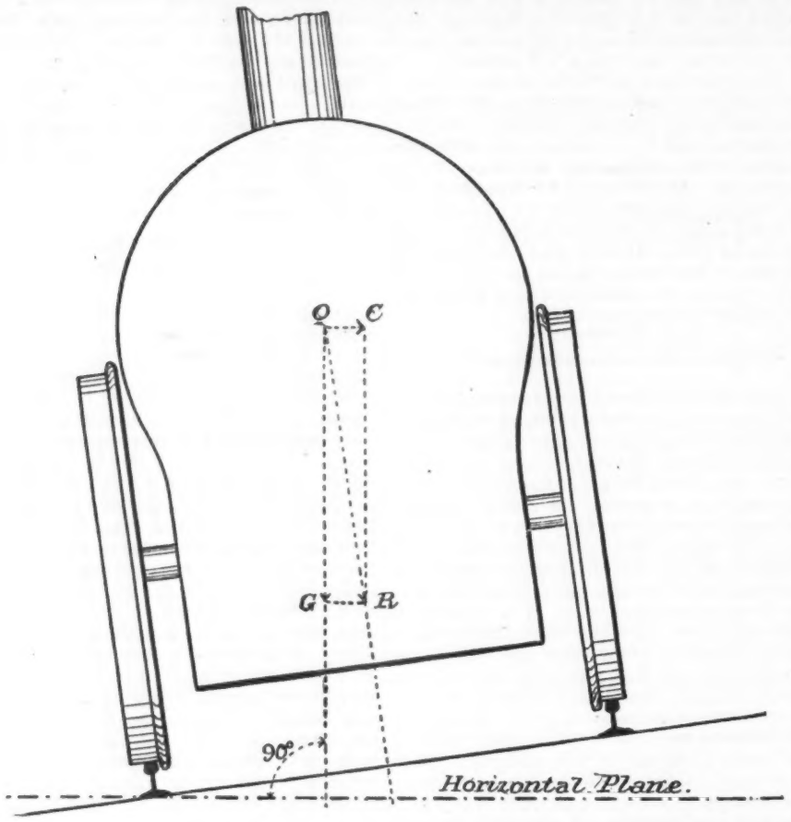
Coal Dust Explosions.

George G. Andre says: Had the German Commissioners not demonstrated the possibility of bringing about an explosion of coal dust by the agency of a shot, an accident that happened on the 7th ult. at the Nœux collieries in the Pas-de-Calais, France, might have been adduced as evidence of that possibility. As it is, we may cite the accident as another illustration of the demonstrated fact. It appears that a shot was fired in a working place, the atmosphere of which was laden with coal dust without fire-damp even in a minute proportion. The result was an explosion of considerable violence, the inflammation of the dust extending upward of 150 yards. Three men, who were at work in the tram road, were killed. This explosion is utterly at variance with the conclusions of the French Commissioners who recently reported on the subject that of coal dust explosions, and strikingly in accordance with the facts observed by the German Commissioners during their experiments at Neunkirchen. At these Neunkirchen experiments, it was observed that a tamping of small coal or carbonaceous clay greatly lengthened the flash from a blown-out shot. These long projections of flame have been the cause of several serious accidents lately in France. With the view of removing this source of danger, a committee of inquiry has been formed.

REVERSE BLUE PRINTS.—The French process, brought forward by M. Pellet, for the photographic reproduction in blue lines on white paper of industrial drawings, plans, maps, etc., is thought to have some special advantages. It is based on the property of perchloride of iron being reducible to protochloride by light, the latter salt not being changed by a solution of prussiate of potash, while the former is immediately colored blue. The copying paper is sensitized by immersion in a bath formed of one hundred of water and ten of perchloride of iron, and five of oxalic acid, or other vegetable acid. The drawing, on transparent paper, is placed on a dry sheet of the copying paper, and exposed to the light under glass, that is, fifteen to thirty seconds to the sun in summer, forty to seventy seconds in winter, and in the shade, the exposure varying from two to forty seconds, according to weather. After exposure, the sheet is placed in a bath of prussiate of potash, fifteen to eighteen per cent. of water, which immediately colors blue all the parts where the perchloride has remained intact, but does not affect the parts where the salt has been reduced by the light. Then the drawing is washed with water, and passed into an eight to ten per cent. bath of hydrochloric acid, which removes the salt of protoxide of iron, when it is washed again and dried. The drawing now appears in deep blue tints on a very white ground, its appearance being that of a drawing made by hand with blue ink. *Providence Journal.*

AIR-GUN. First mentioned in David Rivault's "Elemens d'Artillerie," who ascribes the invention to a certain Marin, of Leisiux, about A. D. 1600.

FIG. 115.—ELEVATION OF OUTER RAIL.



TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 92*).

If one rail is lower than the other or is uneven in itself, for track can be out of surface both laterally as well as longitudinally, the depression will cause the truck to lurch down, and the blow or pressure thus given, not only increases the trouble, but also forces the track out of line. Thus are gauge, line and surface mutually related, so that an error in one soon leads to an error in the other two. To avoid those very disagreeable sensations of a car inclining, or the still worse, rolling, oscillating motions, the vertical surface of each rail must not only be kept true, but the tops of the two rails must be in the same horizontal plane. To obtain this a constant use of the spirit level must be insisted upon. Track should never be worked over without keeping the level across the rails and noticing that they are level horizontally. When on a tangent, for on curves the rails are no longer in the same horizontal plane, since the outside rail is elevated to compensate for the centrifugal force developed in the train, it is necessary to compensate for this force; because, acting in the direction of the radius, it throws the wheels against the outside rail, producing not only greatly increased wear of that rail but also greater flange friction, adding extra work to the engine. If all the weight of the train were on a level with the rails, these would be the only reasons for superelevation, but since the center of gravity is elevated above the rails about 4½ to 5½ feet in engines, and 8 feet in passenger cars, centrifugal force tends not only to press the wheels against the outside rail, but also to cause the cars to revolve about that rail as a center. This produces the unpleasant tipping of a car toward the outside, experienced when passing around a flat or insufficiently elevated curve. Let Fig. 115 represent a skeleton cross section of an engine where O is the center of gravity, O C the centrifugal force acting horizontally, and O G the direction of the weight due to gravity acting vertically. When the radius of the curve is infinity, that is a tangent, O C is zero and O G is perpendicular to the horizontal plane of the rails. As the curve increases the centrifugal force becomes more and more sensible since an expression of its value is

$$\text{cent. force} = \frac{\text{Weight} \times (\text{velocity})^2}{32.2 \times \text{radius}}$$ and the

body is acted upon by the two forces, and in order to balance this horizontal component, the plane of the rails is inclined so that the direction of the resultant or of the two forces will still be perpendicular to it as was the direction of the weight alone when the centrifugal force was zero.

Knowing the speed and the radius of the curve the proper elevation can easily be calculated by the following formula:

$$\text{elevation} = \frac{d\ V^2}{32.166\ R.}$$

Where d denotes properly the distance between rail centers, considering them as the bearing points, although d is usually taken as the gauge. V denotes the speed of the train in miles per hour, and R the radius of the curve. It will thus be seen that the elevation increases as the square of the speed of the train, that is to double the speed requires four times the elevation.

(TO BE CONTINUED.)

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† NOTE: To accompany Fig. 114.

Doors. The two exterior doors to be 2 ft. 8 in. wide, 6 ft. 8 in. high. The six interior doors to be 2 ft. 6 in. wide and 6 ft. 6 in. high.

Windows. Of two sashes; lower 2 ft. 4 in. by 2 ft.; upper 2 ft. 4 in. by 1 ft. 11 in. Bottom of lower sash, 2 ft. 4 in. from floor.

Casings. Of doors and windows to be pine, 4 in. by 1 in.

Thresholds of doors and *Sills* of windows to be oak, 4 in. by 2. in.

Walls and *Partitions* to be double boarded with 1 in. boards.

Stairs. 11 steps—12 risers 7¼ in.—11 treads 9 in.—the large step 2 ft. 10 in. by 2 ft. 8 in.—8 in. rise. Stairs 2 ft. 8 in. wide.

Railing at head of stairs; 2 posts 3 ft. 3 in. by 5 in. by 2 in. 2 rails 7 ft. 3 in. by 4 in. by 1 in. 2 rails 2 ft. 9 in. by 4 in. by 1 in.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY JAMES B. CROES, M. SOC. C. E.; INST. C. E.
(CONTINUED FROM PAGE 78)

DCCLXVIII.—SHAMOKIN, PA.

Shamokin, Northumberland Co., Pennsylvania, in lat. 40° 55′ N., long 76° 45′ W. is on Shamokin creek in the antracite coal-fields.

It is an incorporated borough. Water-works were built in 1873, by a private company, the supply being taken from surface water.

The main supply is drawn from a small reservoir formed by a dam across Eagle River, holding 250,000 gallons, 3½ miles distant from and 150 feet above the town. Two other dams across the same stream, 60 and 20 feet above the town respectively, having a combined capacity of 3,500,000 gallons, are used in times of drouth, the water being pumped by 2 8-inch pumps directly into the mains. The pumps are generally in use three or four months each year. From the reservoir first mentioned a 12-inch cast-iron pipe conducts the water to the town, and it is distributed by 6½ miles of cast-iron pipe of 10 to 3 inch diameter with 25 fire hydrants and 1600 taps. Service pipes are of galvanized iron. No meters are used. The borough pays $15 yearly for the use of each hydrant. The daily consumption is 230,000 gallons. The works have cost $110,000. There is no bonded debt. The yearly expenses of maintenance are $1,500 and the receipts $12,000.

The population in 1880 was 8,184. Holden Chester is Superintendent.

DCCLXIX—SHELTON, CONN.

Shelton, Fairfield Co., Connecticut in lat. 41° 20′ N., long 73° 30′ W.

It is unincorporated. Water-works were built in 1881 by a private company taking the supply from surface water. An earth dam forms an impounding reservoir built across Curtis brook sheet piled and puddled with clay, covering 18 acres, and thence the water is conducted to a distributing reservoir one mile further down the stream. This reservoir is formed by a masonry dam and covers ¾ of an acre, and is ½ a mile distant from and 230 feet above the town.

Distribution is by 4 miles of cast iron pipe with 27 fire-hydrants, one meter and 102 taps, of which 12 supply factories. Service pipes are of galvanized iron. The town pays $30 annually for the use of each hydrant. The works have cost $30,000. There is no bonded debt. The yearly expenses of maintenance are $500, and the receipts $2,500. The daily consumption is not known. The population in 1880 was 1,362. D. S. Brinsmade, in Secretary.

WATER

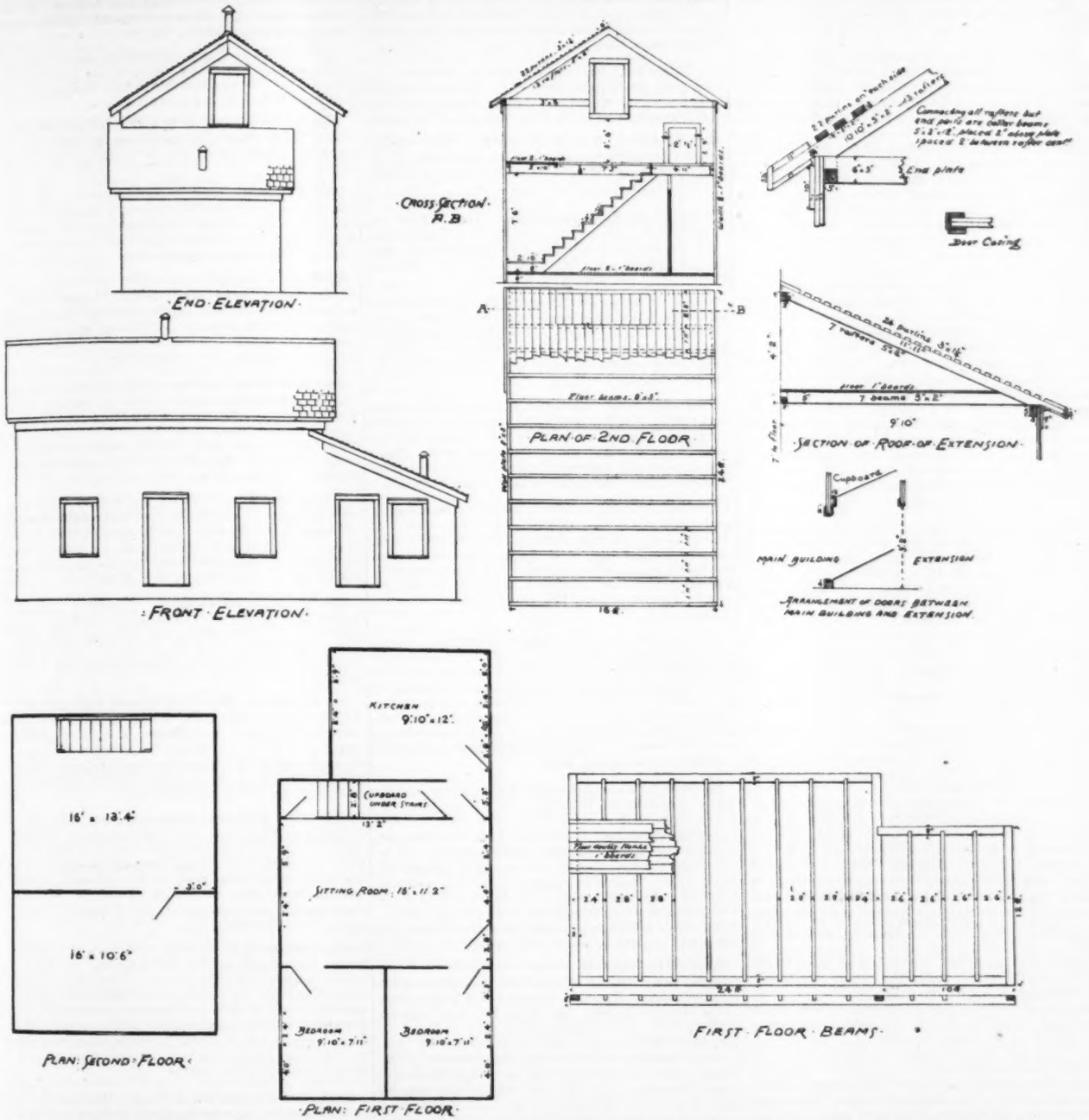
C. E. GRAY, JR., has closed a contract with Phelps & Moffit to lay six miles of pipe for the Monomonie Waterworks, Wis.

GRAND Island's (Neb.) proposition for water works is to include a $5,000 building for city purposes, five miles of mains, a hundred foot stand pipe—bonds asked for not more than $37,000.

A SURVEYING corps is now at work up the river from Laredo, Tex., to ascertain the practicability of irrigating the valley lands. It is said that eastern capitalists are backing the movement, and great hopes are entertained for its feasibility.

THE water of Charleston, S. C., which is obtained wholly from artesian wells by its chemical action on starch, discolors rice, hominy, etc., to some extent and imparts a slightly unpleasant flavor to tea and coffee. It is as soft as any spring water, however.

FIG. 114.—DWELLING SHANTY.* (See page 92.)



THE Ashland Water Company has begun the erection of another reservoir at Frackville for additional storage and that the present reservoir can be repaired.

J. J. NEWMAN, of Providence, R. I., has just closed a contract with North Attleboro, Mass., to furnish and lay 4¼ miles of pipe—2000 feet 8-inch, 1500 feet 4-inch, and the rest 6-inch—for the waterworks of that place The fire hydrants will be Ludlow make, the Peet Valve Co. furnish the gates. We are indebted to L. L. Gerry, Engineer and Superintendent of the North Attleboro Waterworks, for the above item of news.

THE letting of contracts for making the big ditch that is to drain the Dakota county slough is postponed till the 27th inst. The ditch is four and one-quarter miles long, is estimated to contain 46,952 cubic yards of excavation, is to be ten feet wide on the bottom and fifteen feet wide on top, and from two and one-half to seven and one-half feet deep, with eight feet burm. Bids will be received for the entire job, or for any one of the seventy-four sections into which the work is divided.

ANOTHER test was made, August 4th, of the Eau Claire, Wis., water works system on the west side of the Chippewa river, the pipes being connected with those of the Shaw Lumber Company. The trial was made in the presence of Mayor Day and a number of aldermen, and the result was satisfactory. The water works company has now about two hundred and seventy men in service, and are rushing the work to a speedy completion.

A PROPOSITION has been made to Tallahassee to supply it with water by means of a pump carrying 200 gallons a minute, and several reservoirs, all for $25,000.

PREPARATIONS are being made to sink the waterworks well at Springfield, Ind., seven and a half feet deeper than it is at present.

THE Superintendent of Public Works of Hyde Park, Ill., has reported that the covers had been removed from the new inlet crib of the water-works tunnel the gratings put in place, and that the village was now being supplied with water through the tunnel. He recommended that the soil around the crib be replaced with cement at a cost of about $2,500. The matter was referred to the Water Commissioner and the President with power to act.

THE village of Hyde Park, Cook Co., Ill., advertises until August 31st, for a 12,000 000 U. S. gallon pumping engine. It must be of the horizontal compound, condensing type; the duty required is 100,000,000 foot pounds on a 24 hour test. Calculated on an evaporation of 10 pounds of water to one of coal; the steam pressure not to exceed 75 pounds per square inch, and the engine to work easily against a fire pressure of 150 pounds per square inch. The Hyde Park tunnel is now in use but not yet completed.

REMOVAL OF INCRUSTATIONS FROM WATER-MAINS BY DILUTE ACIDS AND SODA.—A successful attempt was made last year in Leipsic to remove by chemical means the incrustation that coated the interior of the force-main from the pumping station to the reservoir. The main is 390 millimeters wide (about 15¾ inches) and 4.55 kilometers long, and the incrustation was from 13 to 24 millimeters thick, and in places thicker still. The operations lasted from the 7th of March to the 11th of May, and during that period at intervals the pipe was filled with dilute hydrochloric acid eight times, with soda solution three times, and with a solution of chloride of lime once, being washed out thoroughly with water between the successive applications. It was stated that the incrustation was entirely removed, and the practical effect of the cleaning was indicated by the pressure gauge, there being a decrease of from 1.8 to 2 atmospheres pressure at the pumps.

AN Artesian well, at White Plains, Nevada, has been sunk over 2,300 feet, and can go no further until the water is shut out. The water is 17 per cent. salt, and is so heavy that the rope and tools float in it, and the drill does not penetrate the rock. All attempts at shutting it out have failed thus far as a last resort. The men are now at work constructing an ingenious device consisting of a hollow cylinder of two-inch rubber, two feet long and of a diameter sufficient to fit around the iron pipe. This is put on the pipe a foot or two from the bottom, at a joint. When it goes into the well, the tons of pipe above it press down and expand it, filling every crevice in the well completely, and shutting off all flow, up or down, outside the pipe. The pipe has been put down once, but the rubber came off, and is now at the bottom of the well. Two have been got out, and as soon as all the rubber is out another trial will be given the device.

THE engineers began the final survey of the proposed Mississippi dam at Brainerd, Minn., Aug. 5th to determine the amount of damages that will acrue from overflowage.

PRAIRIE GROVE, Ark., is making an effort to get a branch of the Frisco from West Fork, via Boonsboro, and the effort will no doubt ultimately result successfully. The people of the three places propose to give the right of way and subscribe $25,000 to the work.

THE Cleveland, O., Board of Waterworks Trustees approved bills Aug. 6th. The total amount ordered paid was $110,000. This is the largest accumulation of claims ever coming before the board. The largest single bill was for $25,000 by McReynolds & Ganness. A bill for pipe amounting to $21,000 was approved, as was also one for the same amount for constructing the superstructure of the new engine-house. There were also bills amounting to $6,000 for work on the waterworks' crib. Bids were opened for building eight light iron bridges at the Fairmount Reservoir. These are to run from the embankment to the valves, and will have an average length of fifty feet. The bids were as follows: Buckeye Machine Company, $5,395.75; Woodhill & O'Gorman, $5,367; Variety Iron Works, $4,820; H. G. Welty, $4,220.27; The King Iron Bridge Company, $4,099; Thomas Manning & Co., $3,847. A contract will be entered into with the latter company. The board will meet again on Wednesday, August 19th., when the bids for the eight or ten thousand feet of fencing at the same reservoir will be opened. There will also be a meeting of the board Saturday, August 15th, when bids for supplying the department with ten thousand tons of coal will be received.

WHAT 5¼ INCHES OF RAINFALL MEAN.—Few readers of a newspaper except those of a mathematical turn of mind, can stop to think of the immense tonnage of water that is represented in a rainfall of two or three inches over a given area. Chicago covers an area of about 28 square miles, and each square mile contains 27,878,400 square feet. A square foot contains 144 square inches. A wine gallon contains 231 cubic inches. A rainfall of 1.6 inches is equivalent to one gallon to the square foot. One evening there had fallon 5.48 inches, and by midnight it must have amounted to 5¼ inches. This is at the rate of 3 3-11 gallons to the square foot, or 91,238,400 gallons to the square mile. Therefore, over twenty-eight square miles covered by Chicago, there fell during 24 hours the enormous quantity of 2,554,675,200 gallons of water, the equivalent of 63,866,880 barrels of 40 gallons each. A gallon of water weighs 8⅓ pounds. On this basis the weight of the fall was 108,444,500 tons, or 15.2 tons for each one of its 700,000 inhabitants. Assuming that the river is 200 feet wide by 15 feet deep, the quantity of water which fell would give a section of the stream 113,736 feet in length, or over 21¼ miles. To put it in another shape, the pumps at the water works have a daily capacity of 100,000,000 gallons. To remove the water which fell in this city, during the twenty-four hours would require the constant service of the pumps for 25¼ days.—*Chicago Times.*

FINDING WATER IN THE DESERTS OF TUNIS.—PARIS, July 19.—At the last meeting of the French Geographical Society, held on Friday night, M. Ferdinand de Lesseps gave an account of the recent success of the operations conducted with the object of finding water in the desert tracts of Southern Tunis.

Two years ago, M. de Lesseps, in company with M. Roudaire, visited the region of the Shotts. They observed there, on the banks of the Wady Melah, a lake in which the level of the water never sinks. This water was excellent. M. de Lesseps thought, although there was no visible confirmation of the fact, that this water might be in communication with a deep sheet of water. In consequence, he requested the engineers to make borings, or to sink a well at that spot. They have succeeded admirably. At a depth of 91 metres they reached the sheet of water sought for. The flood rushed from the ground with such velocity that it raised with it stones weighing 12 kilogrammes, and threw them to a great height into the air. The well yields 8,000 cubic metres of water a minute.

When the fact was known in the country it caused great excitement. There were more than 400 hectares which would be planted with palm trees, and on which an attempt would be made to rear ostriches.—*London Times.*

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

R. R. Bridges in New York State.—There are 3,500 railroad bridges in the State of New York.

The Lehigh Valley Railroad Company, is relaying its main road bed with 78-pound rails of the Sayre pattern.

The Union Bridge Company, through their agents, Messrs. Bachelder & Winns, are pushing the work on the Kentucky and Indiana bridge approaches, New Albany, Ky.

Vicksburg and Meridian.—Every preparation is being made, it is stated, for the change of gauge of the Vicksburg and Meridian Railroad to the standard gauge. It is asserted that the work of changing will be done about Sept. 1.

The Pike's Peak Railroad, is now in operation at a point over 1,200 feet above sea level. When the road is completed it will mount 2,000 feet higher than the Lima and Oroya Railroad in Peru, the highest in the world.

The Vandalia's New Iron Bridge.—The Vandalia Railway Company has finished the east span of the new wrought-iron bridge over White river. It is made entirely of wrought-iron.

Tehuantepec Surveys.—EL PASO, TEX., August 5.—Surveys will soon be resumed on the Tehuantepec Railroad, and its completion is looked for in the near future. Prieto, a Government engineer, goes to Tehuantepec to act as Chief Engineer.

Work on the St. Joe Branch of the Rock Island has been commenced by a large force of men and teams. In Daviess County, Mo., the other end of the road, 1,000 men will soon be put on. The grading must be completed by November 1st, and the track must be laid by January 1st, 1886.

Illinois R. R'ds.—Illinois leads all the States in railroad mileage. It has 8,909 miles; Pennsylvania, 7,546; Iowa, 7,500, New York, 7,335; Ohio, 7,276; Texas, 6,198; Indiana, 5,534; Michigan, 5,233, and Missouri, 4,709. These are the nine great railroad States. All of the New England States have together 6,307 miles of railway.

The Coshocton and Southern Railroad Company.—have organized by the election of E. T. Spangler, J. C. Pomerene, H. C. Herbig, John C. Fisher and J. W. Cassingham as Directors. J. W. Cassingham was elected President, and C. H. Blood Secretary and Treasurer. The object of the organization is to build an extension of the Connotton Valley Railroad from Coshocton, O., to Zanesville.

Denver, Memphis and Atlantic Railway.—A contract for the above road was recently let to Fitzgerald & Mallory for building 325 miles of this road. Grading is now in progress at Belle Plaine, Kan., on the first section of sixty-one miles, and a full force will be on the ground within ten days. It is the intention of the contractors to have this section in operation by January 1, 1886. The company is said to have about $1,000,000 in subsidies on 325 miles of road.

The South Penna. Railroad—According to late reports, the work of tunneling is still going on the South Penna. R. R., though the work is much reduced and those working are put on half time. The contractors have had it hinted to them that it would be well to stop work without official orders so to do. Meanwhile the residents along the line are considerably outraged at the proposed suspension of work; especially those who have given the right-of-way to the company gratis and have a bank across their land or a hole in the ground as a return for their confidence.

Close Adjustment of Fares.—Perhaps the closest figuring done yet by a railroad manager is that recently done by President Mackey of the Evansville & Terre Haute Railroad. For years the fare between Sullivan, Ind., and Terre Haute has been 80 cents, on the basis of the distance being twenty-six miles. But a new and perhaps more exacting measurement of the distance made it six and a half feet over twenty-six miles. Promptly upon the discovery of this fact the fare was raised to 85 cents. As there is considerable travelling between the two places the extra six and a half feet will cost the people a few thousand dollars in the course of a year.

B. & O. Bridge at Wilmington, Del.—WILMINGTON, August 4th.—The large iron bridge spanning the Brandywine, in the Western suburbs of this city, constructed by the Baltimore and Philadelphia Railroad Company, has been completed, and the first cars crossed it to-day, drawing cross ties to be used in extending the lines of rails into Pennsylvania. The bridge is 108 feet high, 350 feet long, and structurally one of the handsomest and most substantial bridges in this part of the country. The cost was about $200,000.

The Transvaal Railway.—There are still strong hopes, according to the *Manchester Guardian*, that a railway will be built from Lorenoz Marquez, a Portuguese possession on the east coast of Africa, to Rustenberg, an interior town of the Boers in Transvaal. Ineffectual attempts were recently made in Amsterdam to raise funds for the construction; but it is expected that even if Rustenberg cannot be reached a railway will be built part of the way inward. If the project be carried through, Port Marquez may prove a successful rival of Natal and Cape Colony; and this would especially be the case if the mineral resources of the region pierced prove valuable. Coal, copper, iron and lead are all indicated on geological maps. This new port might become a coaling station for vessels engaged in eastern shipping, and as a source of supply there would be a saving of 1,428 miles in distance to India, as compared with obtaining supplies from England.

Steel Rails.—The first installment of steel rails from the Cambria Steel Works, Johnstown, under a contract for 25,000 gross tons, has been shipped for the St. Paul, Minneapolis and Manitoba Railroad.

300 Coal Cars.—The St. Charles Car Manufacturing Company has contracted to build 400 coal cars for the Kansas City, Clinton and Springfield Railroad, to be delivered within the the next sixty days.

Completion of the C. P. R.—Mr. A. Onderdonk, contractor for the British Columbia section of the C. P. R., states that the whole line will be completed by the 1st of October.

Changing to Standard Gauge.—CLEVELAND, O., Aug. 5th.—It has been officially announced that the Connotton Valley Railroad will be changed to the standard gauge. Material has been ordered for this purpose, including 10,000 standard gauge rails.

Wisconsin Central.—Articles of incorporation for the Superior route of the Wisconsin Central, to run from Chicago to St. Paul, passing through Stephenson county, Ill., have been placed on file in the recorder's office at Springfield. The capital stock is $20,000,000, and the president is Henry Allison of Chicago.

New R. R. Shops at Indianapolis.—The I., B. & W. people have commenced the erection of shops on the West side, and already have one building up, sixty feet wide by 100 feet long, and are putting in some $15,000 worth of new machinery. Other buildings will be erected as fast as the finances of the company will allow.

A Notice with Proviso's.—The following is a notice posted in a Post Office on the Georgia Pacific Railroad: "Notice—The males on the Ga Pac arrived every day at 10.40 A. M. and 5.25 P. M. unless the R. R. runs off the track or an old engine gits out fix, or the biler busts or something else happens you no." Resp P. M.

The Morse Bridge Company, is said to have received the contract for building the Robert Street Bridge at St. Paul, Minn., for the sum of $191,000. Among the bidders were the Keystone and Phœnix Bridge Co., and Rust & Coolidge and Alden & Lassig of Chicago,

The Debt of the New York Central Railroad, with the West Shore extension added, is $227,000,000, the largest of any in the United States, if not in the world. The debt of the Erie Railroad is $160,000,000, the Pennsylvania $150,000,000, the Baltimore and Ohio, $91,000,000. The combined liabilities of these four trunk lines exceed one-third of the national debt.

Railways in Palestine.—Modern railways are about to invade the Holy Land in several directions. Turkish capitalists have obtained concessions, and will build lines immediately from Alexandretta to Aleppo, along the bank of the Euphrates, and eventually to Damascus. The aim is to connect the Syrian Sea with the River Euphrates, one of the most important highways of Asiatic trade.

The Dubuque & N. W.—The surveyors on the Dubuque and North-western are pushing the survey with all possible dispatch in order to let the contractors get to work. As much grading as possible will be done this season, although the connection with the Minnesota and Northwestern will hardly be made until late in the season of 1886. This Stickney road and its combinations promise to be an important factor in Northwestern railroad affairs.

An Air-Balloon Railway is about to be constructed on the Gaisberg, near Salzburg, Germany, a mountain of no great height, but offering a magnificent view over the beautiful neighborhood of the town. The balloon, which will have grooved wheels on one side of its car, will ascend a perpendicular line of rails, constructed on the principle of the wire-rope railway invented years ago for the Righi, but never realized.

A Proposed Railway.—MADISON, WIS., Aug. 6th.—Articles of Association were filed with the Secretary of State, to day, of the Lake Superior & Southwestern Railway Company, capital stock, $4,000,000. The company designs constructing a line from Superior City southwest through Douglas, Burnett, Polk and St. Croix Counties to St. Croix Falls, thence southeast, through St. Croix and Dunn Counties to Menomenee; total distance, 160 miles. The incorporators are J. H. Hayward of West Superior, W. V. Wood and C. L. Catlin of Superior, and W. G. Cummin and Joseph King, of St. Paul.

Dynamiters on the South Penna. R. R.—McCONNELLSBURG, Aug. 5th.—An attempt was made early this morning to blow up the commissary and other buildings of G. G. McGhee, one of the contractors of the South Pennsylvania Railroad, at a point seven miles north of this place. A dynamite cartridge was placed under a Hungarian shanty, and its discharge wounded Hungarians; another was put under the commissary, the explosion of which played havoc with the building and its contents, and a third was found secreted under the building in which Mr. McGhee was stopping, but the fuse went out. A liberal reward has been offered for the arrest of the perpetrators.

The Manchester Ship Canal Bill Passed.—LONDON Aug. 5.—The Manchester Ship Canal bill passed the House of Commons late this evening. The news of the final passage of the measure caused great rejoicing at Manchester, where impromptu torch-light processions were gotten up late at night, fireworks set off, and speeches made to the crowds in the streets by prominent citizens.

The Winona and Alma to Resume Work.—A rumor is current that construction work will be resumed on the Winona, Alma and Northern Road August 15 and pushed with all possible speed until the close of the season. The report comes from agents who have been engaged in closing right of way contracts during he last ten days. It is believed that this road will be part of the Chicago, Burlington and Northern, and that it will cross the river at Prescott and enter St. Paul over the Minnesota and Northwestern track.

Iron Locomotive Cabs.—The Manhattan Elevated Railroad Company of New York, has experienced considerable trouble ever since the road was opened with the locomotive cabs shaking to pieces or rotting out. The life of a good wooden cab seldom exceeded five years. To obviate these difficulties the mechanical department has recently designed an iron cab from which great durability is expected. No. 12 sheet iron is used, stiffened with angle irons. Wood is not used at all, except for framing to hold the windows. Formers have been made for bending the sheets to the proper shape, and templets for laying the sheets out on, and the intention is to supply all engines with cabs of this description as fast as renewal is necessary.

Canadian Pacific Earnings for July.—NEW YORK, Aug. 7th.—The gross earnings of the Canadian Pacific Railway for the month of July are reported at $890,000, an increase over the corresponding month last year of $318,000. The Chicago, St. Paul, Minneapolis and Omaha reports gross earnings for July at $468,800, an increase of $1,700. The gross earnings of the Denver and Rio Grande for July were $548,295, an increase of $147,595. For the seven months ending August 1st, the gross earnings were $3,265,857, an increase of $348,897.

The gross earnings of the St. Paul and Duluth Railroad for July amount to $134,854, and for the six months beginning with January, $619,490. The corresponding figures for 1884 are $119,499 and $613,107 respectively, and for 1883, $137,994 and $652,021.

Contracting.

St. Paul Street Grading.—The Board of Public Works, St. Paul, Minn., will receive bids for street grading until Aug. 17.

Gas Works at Lexington, Ky.—The city of Lexington, Ky., solicits bids for the construction of gas works and also for making and supplying gas.

Paving Blocks.—The contract for 90,000 paving blocks for Main street, Gloucester, Mass., has been awarded to William Gove, of Worcester, at eighteen cents per square yard. H. Gove & Co. of Boston bid 25 cents.

A Baltimore Culvert.—Mayor Latrobe, of Baltimore, Md., has given orders for rebuilding the culvert under the bed of Lafayette avenue, near the Baltimore and Potomac Railroad, which was washed away on July 26th. The contract was awarded to Patrick Reddington at $3,488. The other bidders were Owen Patterson $3,547; Jonn Lyons, $3,813.45, and J. B. Bates, $3,600.

New Iron Bridge Across the Susquehanna River.—The contract for the new iron bridge across the Susquehanna river at Williamsport, Pa., has been awarded to the Berlin Iron Bridge Co., of East Berlin Conn. The bridge will be of iron, consisting of five spans, parabolic truss, 200 feet each, or a total of 1,000 feet, being one of the longest iron highway bridges in the State.

Trenton's New Capitol.—TRENTON, Aug. 11.—The Capitol Rebuilding Commission to-day appointed Mr. Broome, whose plan for a new structure was adopted, as supervising architect and directed him to proceed with the working plans and specifications. Mr. Broome expects to have them finished about September 1. The work of excavating for the foundations will begin at once.

A Bridge Built in a Day.—On Monday an iron bridge on the Lehigh Valley railroad at Clinton, N. J., was swept away by the flood. On Tuesday the road from Phillipsburg to New York was abandoned and trains run from Easton over the Jersey Central to Elizabeth. By Wednesday the iron structure was replaced by a wooden bridge and travel was resumed. The bridge was about 100 feet long and the quick work of the Lehigh Valley is considered a great feat.

A Large American Ship.—ROCKPORT, ME., Aug. 11.—The four-masted ship Frederick Billings was launched to-day at Rockport. She is the second largest ship ever built in the United States, and the only four-masted ship. Her tonnage is 2628 tons; length, 291 feet; from deck to main truck, 121 feet. Her masts will extend 70 feet above the Brooklyn Bridge, and three of the four sections will have to be lowered in order to pass under that structure. Her total cost is $150,000.

The Robert Street Bridge, St. Paul, Minn.—This bridge just let to the Morse Bridge Co. of Youngtown, O., is described as follows:

The total length of the bridge is more than 1,500 feet; consisting of one span of 350 feet, three spans of 200 feet each, one span of 170 feet, one span of 150 feet, one span of 65 feet, and about 250 feet of trestle work approach The width of the bridge is 54 feet, with a clear roadway of 32 feet, and two sidewalks of 10 feet each, designed for the heaviest traffic. The contract price for the superstructure is $191,000.

The Sewer from the State Asylum for the Insane at Binghamton, N. Y., for which an appropriation of $13,000 was made at the last session of the Legislature, will soon be built. Plans for this sewer have been made by the engineer employed by the Trustees of the Asylum, Mr. Horace Andrews, of Albany, N. Y., and have received the approval of the State Board of Health as required by law. The bids for constructing the sewers will probably be advertised within a few days in the Binghamton papers.

The approximate quantities on which bids will be made are:

2,596 ft. 8-in. vitrified pipe.
8,622 ft. 6-in. cast iron pipe.
700 ft. 10-in. vitrified pipe with house connection.
9 man-holes.
2 lamp-holes

Also, if the trustees direct, about 1,100 feet of 8-inch pipe will be laid from the new buildings now being erected. The Secretary of the Trustees, Mr. H. G Rodgers, of Binghamton, will furnish any desired information to contractors who may wish to bid for this work. We are indebted to Horace Andrews, C. E., for the above item.

Government Work.—Col. Roberts, in charge of the improvements on the Delaware River, after speaking of works in detail at different points, says: "The immediate permanent improvement of the Delaware River, including the maintenance of a twenty six-foot channel 600 feet wide from the upper part of Philadelphia to deep water in Delaware Bay, would cost, if the expenditure were capitalized, about $6,000,000. It is certainly a small price to pay for such benefits, considering the magnitude of the interests involved. An appropriation of $600,000 is recommended for the fiscal year ending June 30, 1887.

Lt. Col. Poe, in charge of improvement of rivers and harbors in Michigan, submits the following statement concerning work in his department:

RIVERS AND HARBORS.	Available.	Asked for.	Required.
	$	$	$
Detroit River	149,385	167,986	.....
St. Clair Flats, canal	.....	153,289	153,298
Clinton River, new	.....	32 926	32,926
Lake Huron Harbor of Refuge	24,522	100,000	100,000
Saginaw River	8,509	165,800	371,000
Arable Harbor	4,900	.....	.....
Thunder Bay Harbor.	4.535	10,000	10,000
Hay Lake Channel	124,207	500,000	2,334,155
St. Marys, Fall Canal	.....	250,000	1,750,000
Dry Dock, St. Marys Falls Canal	.....	150,000	3,223,872

Board of Public Works, St. Paul, Minn.—The engineer sent in on August 2, the following estimates for paving Robert street. With the Kerr pavement the estimate is:

Excavation	$ 537 50
Paving	12,600 00
Curbing	2,295 60
Rolling	150 00
Total	$15.583 10

The cedar block estimate is:

Excavation	$ 537 50
Paving	6,825 00
Curbing	2,295 60
Rolling	150 00
Total	$9,807 10

The pine block estimate is:

Excavation	$ 537 50
Paving	5,250 00
Curbing	2,295 60
Rolling	150 00
Total	$8,233 10

The contract for the College avenue sewer was awarded to Pat Butler for $850; for grading Greenbriar street, York to Maryland, to F. Beyer for $4,988.64; for grading Olive, to P. H. Thornton for $1,189; for grading Jessamine street, Forest to Edgerton, to J. F. Millian for $9,244. All the bids for grading Payne avenue were rejected, and the clerk ordered to advertise for bids. The engineer's pay roll for July amounted to $2,556.67. On the bids for grading Reaney avenue, Thomas D. McCarthy, one of the bidders, was asked to appear before the board at its next meeting. The bids for the paving of Sixth street were as follows:

Estimate	$24,885
P. H. Thornton	22,871
Andrew Jaicks	21,280
A. Wanzer	25,900
J. W. Doherty	22,774
Forrestal Bros	21.230
J. J. Palmer	23,879
Wm. Forrestal	23,420
S. P. Folsom, Jr.	22,400
J. H. Fielding	21,868

City Engineer Rundlett made the following report:

In accordance with the order of the common council approved August 25th, and your order of April 27th, I submit herewith the preliminary estimate for the partial grading of the street opened for the levee in the Sixth ward. The levee to be 40 feet wide and of full height and five feet from the south line thereof, and from the west line of block C, of Banning & Oliviers addition to West St. Paul to the east line of Amb's addition to West St. Paul, with the necessary slopes and riprap to protect it from being washed by the river. I have had the street carefully surveyed and cross-sectioned, and estimate as follows:

Embankment, 237,360 cubic yards at 25 cents	$59,340
Slope wall for protection, 33,000 square yards at $1	33,000
Total	$92,340

I have figured the thickness of the slope wall at an average of one foot, and believe that this will afford sufficient protection if properly laid. I have also, in accordance with your direction, made a survey for the outer line of the levee between the same points, giving a general width of levee of from 100 to 150 feet. I submit preliminary estimate for the embankment 20 feet wide on top slopes 1, ½ to 1—river side protected with a slope wall as in previous estimate, as follows:

Excavation, 190,333 cubic yards at 25	$47,583.25
Stone slope wall, 44,550 sqr. yards, at $1	44,500.00
Total	$92,108.25

That part of the levee intended for a steam-boat landing should, I think, have a flatter slope and better construction, adding, perhaps $5,000 or $6,000 to the above estimate. I do not think that either of these plans would effectually keep out the water from the flat, for, as a matter of course, it would back up from below; but would prevent property being carried away by the floods.

The board, after a discussion, referred the report to the council in favor of the first estimate of the engineer—four voting in favor and one in the negative. A committee from the West Side Citizens' union was present, and presented strong arguments in favor of immediate progress in the levee construction.—*Pioneer Press.*

Miscellaneous.

The Geographical Society of Australasia, has completed arrangements for the exploration of New Guinea.

Wood-preserving by Gutta-percha.—Late Belgian experiments have had the object of preserving wood by exhausting the air from the pores and causing liquid gutta percha to take its place. The gutta-percha is liquefied by being heated with paraffine, and it hardens on cooling after being introduced into the wood.

The International Telegraph Congress, which meets in Berlin on August 10, will be attended by delegates from all the European states and from Brazil, British India, Dutch India, Egypt, Algeria, Cochin China, Japan, Natal, New Zealand, Persia, Siam, Cape Colony, South Australia, and Victoria, as well as from all the great cable companies. The chief subjects of deliberation will consist of various technical questions, including more especially a general reduction of tariffs

Population of N. J. Towns.—A census just completed the population of Jersey City at 153,203; Newark, 152,868; Paterson, 63,280; Camden, 32,887; Hoboken, 37,721; Trenton, 34,386; Elizabeth, 32,047; New Brunswick, 18,258; Bridgeton, 10,005; Plainfield, 8 913; Millville 8894; Somerville, 8454; Passaic City, 8829; Phillipsburg, 8058; Atlantic City, 7916; Rahway, 6861; Bloomfield, 6592; Montclair, 6377; Perth Amboy, 6311.

The Deepest Bore-hole.—According to a paper read by Herr Mohr before the Magdeburg district association of the society of German engineers, the deepest bore-hole in existence is that bored for coal, near the village of Schladebach, on the railway between Corbetha and Leipzig. The total depth of this bore-hole, which has been driven with a hollow diamond-pointed rock-drill and water flushing, is 4,559 feet. Its diameter at the bottom is 1.873 inches, and at the surface 11 inches Boring operations have been carried on for three years and a half, and a sum of $25,000 has been spent in reaching the depth attained. The temperature in the lower portion of the bore-hole was found to be 48° C., equal to 118.4° F.

Iron Casting in Victoria, Australia.—Forman & Co., Yarra Bank, have finished six cast-iron columns for the dome of the new English, Scottish and Australian chartered bank at the corner of Collins and Queen streets. Each column measures twenty-eight feet in length, has a diameter of fifteen inches, and weighs between seventeen and eighteen tons. They are each guaranteed to withstand the immense pressure of 250 tons. Three of them were recently tried and fully answered all requirements. The casting of the columns has been carried out by Phillips, McWalters & Co. This is said to be the first work of the kind ever erected in the colony of Victoria.—*The Ironmonger.*

The Vast Bed of Pitch which extends from a point far inland in South America to the center and South of Trinidad ends there in the famous pitch lake. The bed dips under the sea in the Serpent's Mouth, as the channel is called which divides Venezuela from Trinidad, and also off the Southwestern coast of the island. Here and there on land and under the sea, in the direction of the strata, springs of liquid pitch bubble up and overflow. The lake is easily accessible by land and sea, being only three quarters of a mile from the shore. It seems to have cropped up to the surface, warmed by the angry breath of some huge subterranean caldron. Numerous cavities or depressions, filled with water, honeycomb its surface, but do not affect its level appearance to the eye of a spectator. The lake is mostly solid; it is mostly in the center that it boils and betrays its volcanic origin.

The Russian stove is made of fire-resisting porcelain, is always ornamental, and frequently a highly artistic, handsome article of furniture. Internally it is divided by thick fire-clay walls into several upright chambers of flues, usually six in number. Some dry firewood is lighted in a suitable fireplace, and is supplied with only sufficient air to effect combustion, all of which enters below and passes through the flue. The productions of combustion, being thus undiluted with unnecessary cold air, are very highly heated, and in this state pass up and down through the different compartments. At the end of this long journey they have given up most of their heat to the twenty-four heat-absorbing surfaces of the fire-clay walls. Then all communication with the chimney is cut off, the fire is put out, having done its work, and the interior of the stove has bottled up its caloric ready for emission into the room, and, passing through the non-conducting walls of the stove, is radiated into the apartments.

Change of Sea Level in the Kurile Islands.—Professor Milne has been engaged in researches on the oscillations of sea level in the Kurile Islands. He finds that the two islands Iturup and Kunashiri form the first two of the series of stepping-stones which connect Japan by means of Kamtchatka with Asia. They contain a greater proportion of rounded hills and of deeply cut valleys than any of the islands farther north, and may therefore be regarded as older than those which are built up almost entirely of finely formed volcanic cones. The neighboring island of Urup presents appearances similar to these two. The formation of an island like Iturup probably commenced as a number of volcanic peaks forming islands, which were subsequently elevated, of which there are indications in the stratified rocks and terrace formations. All the appearances, however which Professor Milne has ascribed to a raising of the land, might, he observes, be also explained by raising and lowering of the sea, such as that which Mr. Croll argues might be produced by the accumulation of ice at the pole; and the fact that the height of the terraces increases northwards appear to confirm this view.—*Science.*

Index to Periodical Literature.

Aerial Navigation.—Describes the dirigible balloon of Tissandier. Length 92 feet, diameter at middle, 30 feet, volume 37,500 cubic feet, filled with hydrogen, ascending power, 2,760 pounds; a Siemens dynamo drove a double bladed screw propeller 9 feet 4 inches diameter. Another French balloon was 165 feet long, 27 feet 6 inches diameter, with a volume of 66,000 cubic feet, ascending power, 4,410 pounds; screw 23 feet diameter at front end of car. Several trials are described. Wm. Pole, M. I. C. E. *Minn. Pro. Inst. C. E.* Session 1884-5. Vol. lxxxi, part 3.

Cable Railroad.—*Kansas City Cable Railroad.* Length 2¼ miles; double-track. Grade from bluff to Union Depot 18.3 in 100. Span over depot tracks 185 feet, pulleys 35 feet apart; cable 1¼ inches diameter, iron wire. Duplicate cable and machinery. The construction, driving-plant, and gripping-gear are described, and a plan, elevation and cross-section given of the grade viaduct at the terminus. *Railroad Gazette*, July 31, 1885, p. 483.

Electric Railroad.—*The Bentley-Knight Electric Railway in Cleveland, O.*—A brief notice of this line which has now been running for a year. This system employs stationary engines and dynamos; the electric conductors are in a conduit between the rails, a conductor attached to the car passing through a slot in the conduit and sliding in contact with the stationary conductor. A comparative summary of approximate expenses of horse, cable, and electric roads is given. Illustrated. *The Electrical World*, August 8, 1885, pp. 57 to 58.

Explosives.—*Heat Action of Explosives.*—Gives the composition of some explosives, and shows the changes which occur when they are fired, with remarks on the substances formed, the heat developed, and temperature and pressure attained. The methods of experimenting are described, tables of results given, with diagrams of work developed, and illustrations of gauges, etc. Lecture by Cap. Noble, M. I. C. E. *Published by the Inst. C. E.* Session, 1883-84.

Ferry Transfer.—*The Portland Car Transfer, Oregon Railway & Navigation Co.* It consists of a trestle incline, grade 1 in 20, 900 feet long, on each side of the Willamette River, upon which runs a transfer carriage. The piles could only be driven 2 or 3 feet: a special form of cast iron pot shoe, with a 24 inch spike was fitted to the piles: the bracing was performed by divers. Weight-boxes are placed between the bents to hold the structure down. The inclines carry a double track and the railroad cars are run on to a carriage, which is pushed by locomotives down to the scow which ferries the cars across. Several drawings are given. *Railroad Gazette.* August 7, 1885. pp. 498, 499.

Locomotive. Passenger engine of the Great Southern & Western Railway of Ireland. Gauge 5 feet 6 inches. Inside cylinders 18 inches by 24 inches. Four wheeled leading truck, wheels 36 inch diameter, four coupled wheels 6 feet 6 inches diameter. Plate frame. Weight in working order 88,480 lbs. *The Engineer*, July 17, 1885. pp. 48, 50.

Metropolitan Railway.—(*See* Railway).

Permanent Way.—Description of Webb's steel permanent way used on the London & Northwestern Ry. Transverse trough ties 9 feet long, 11 inches wide at base, upper table 6 inches wide. Steel chairs of angle brackets rivetted to the ties hold the double-headed rails. Five years in use. Cost compares favorably with present system. Weight of one tie with chairs complete, 184 lbs. *Min. Proc. Inst. C. E.* Session 1884-85, vol. lxxxi, part 3.

Railways.—*The Metropolitan Railways (London).*—An exhaustive paper by B. Baker, M. I. C. E., and J. Wolfe Barry, M. I. C. E. Gives a history of the different projects which have resulted in the present system, and gives particulars of cost, earnings and traffic. The "Inner Circle" line forms a complete belt of irregular form, 13 miles in length, and from it branch various other lines. The grades are short and varied, the ruling gradient being 1 in 70. The line is mostly in tunnel and covered-way, with occasional open cutting with retaining walls, the tunnels are of various forms of cross-section. The width at formation is 25 feet for standard, and 28 feet 6 inches for broad and mixed gauge. The engineering features, and details of cost of the several lines are described and illustrated in detail. *Min. Proc. Inst. C. E.*, session 1884-85, vol. lxxxi, part 3.

Rail Sections.—An article describing the various forms of section adopted on modern railroads in different countries. Eighteen sections are described and illustrated tables of dimensions given; and their advantages and defects pointed out. Edward E. R. Tratman. *National Car-Builder.* August, 1885, p. p. 103, 109.

Water Supply.—A lecture by W. Pole. Gives brief mention of the history from the times of the Romans to modern days. Deals with the quality of water, its impurities and means of improvement; the quantity, showing average consumption; the sources from which it is obtained, viz.—direct collection of rainfall, gathering grounds, rivers, and wells or springs; and the distribution by constant and intermittent supplies. Published by the *Inst. C. E.* Session, 1884-85.

Market Report of Engineering Materials.

New York, August 6, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		1.9c. @	2.2c.
Tee		2.2 @	2.4c.
Beams and channels		3.0c. @	
Tank		2. @	2.1c
Shell		3c. @	3¼c
S sel plates, Tank		2¾c. @	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.			
Butt welded, black	Discount	47½	
" galvanized	"	37½	
Lap welded black	"	65c. @	
" Galvanized	"	7½	
Boiler tubes	"	60 @	
RAILS.			
Steel (large lots at mill)		27.00 @	27.50
Old rails		16.50 @	17.00
Old rail steel		16.50 @	17.00
R R. spikes		1.8 @	1.9
R R. splice-plates		1.55 @	1.7.
R R Track Bolts Square Nuts		2.55 @	2.65
Barb-wire fencing, galvanized		4¾c. @	5¾c
" painted		3¾c. @	4¾c.
Corrugated iron			
Nails			
Iron		2.25	
Steel		2.40.	

METALS.

COPPER.			
Lake Superior		11. @	11¼
Other Brands		10¾ @	11¼
LEAD.			
Com. Domestic		4.12½ @	4.15
Lead Pipe		.06¾	
Tin-Lined Lead Pipe		.15	
Sheet Lead		.06¾	
ZINC.			
Sheet		0.05 @	0.05¼

BRICK.

(Cargoes afloat)			
Haverstraw	per M.	$5.75 @	6.25
Fishkill			
Up-River		5.25 @	5.75
Jerseys		4.75 @	5.75
Long Island			
" pale		3.00 @	3.50
FRONTS.			
Croton red		13.00 @	14.00
" dark		13.00 @	14.00
" brown		12.00 @	13.00
Philadelphia pressed		24.00 @	25.00
Trenton "		24.00 @	25.00
Baltimore "		37.00 @	41.00
Buff "		33.00 @	35.00
Enameled English		65.00 @	130.00
" American		85.00 @	120.00
Fire brick		25.00 @	40.00

CEMENT.

PORTLAND.			
Gibb's English 400 lbs. per bbl		2.75 @	2.90
K. B. & S. " "		2.85 @	3.00
J. B. White & Bros., Portland Cement		2.65 @	3.00
do Keene's Superfine,		8.00 @	10.00
do " Coarse,		5.00 @	6.00
Roman		2.75 @	3.50
Largerdorfer German "		2.55 @	2.80
Dyckerhoff, " "		2.90 @	3.25
Stettiner " "		2.60 @	2.65
Hanover " "		2.60 @	2.65
Vorwohler, Lion "		2.90 @	3.25
Alsen, " "		2.55 @	2.60
Fievе "		2.40 @	2.50
Saylor's American		2.15 @	2.40
Windsor } U. S. C. Co.		1.00 @	1.10
Standard }			1.15
Cable's Portland }		2.15 @	2.40
ROSENDALE cements		1.00 @	1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	0.95	
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.		0.90 @	95
" " No. 2 "		0.75 @	0.80
" " light drab "		0.80 @	0.95
Berlin " in rough "		0.75 @	1.00
Berea " "		0.75 @	1.00
Brownstone, Portland, Ct. "		1.00 @	1.30
" Belleville, N. J. "		0.75 @	1.25
Granite, rough		0.60 @	1.25
Common building stone per load		2.00 @	3.00
Base stone, from 2¼ to 6 ft. lengths, per lin. ft.		0.40 @	3.00

SLATE.

Purple roofing	per square	6.00 @	7.00
Green	"	6.00 @	7.00
Red	"	15.00	
Black Penna. (at New York)	"	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box	per M.	18.00 @	20.0
" Choice	"	55.00 @	80.
Tally plank, 1¼ in. 10 in. dres'd. each.		.44 @	.50
Tally boards, dressed com. "		.28 @	.30
SPRUCE, Boards dressed "		.25 @	.28
Plank, 1¼ in "		.28 @	.30
" 2 in. "		.38 @	.40
" 2 in. dressed "		.43 @	.45
Timber	per M.	20.00 @	22.00
HEMLOCK, Boards	each.	.18 @	.20
Joist, 2¼ × 4 to 4 × 6 in		.17 @	.44
OAK	per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in	"	35.00 @	40.00
YELLOW PINE, Girders	"	25.00 @	30.00
" Dressed flooring	"	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "		5.75 @	6.00
LATH, Cargo rate	"	2.10 @	2.25

PAINT.

Lead, white, American dry per lb	.04¾ @	.05
" " in oil pure "	.05½ @	.05¾
English, B. B. in oil	.08½ @	.08¾
Red, American	.05½ @	.05¾
Litharge "	.05 @	.05½
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11¾
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01¾
Drop black, Amer.	.08 @	.12
" " "	.09 @	.11¾
Chrome green	.05 @	.15
Oxide zinc, American	.03¼ @	.04
" French	.06¼ @	.06¾

The New 12-inch Cast-iron Gun, made by the South Boston Iron Works is showing much power at Sandy Hook. It has been fired fifteen rounds. With an 80 pound projectile and a charge of 265 pounds of powder it has shown a velocity of 1,711 feet and a calculated penetration of iron of 21.25 inches. Its power is equa to that of a short steel Krupp gun of the same caliber weighing 37 tons. The iron gun weighs 54 tons.